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DEPARTMENT OF MINES.

Queensland Geological Survey.

(B. DUNSTAN, GOVERNMENT GEOLOGIST.)

PUBLICATION No. 215.

CLONCURRY COPPER MINING DISTRICT.

PART 1.

WITH 1 PLATE AND 7 FIGURES.

BY

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GENERAL VIEW OF CLONCURRY.

CLONCURRY COPPER MINING DISTRICT.*

PART I.

GEOGRAPHY.

Location.

The township of Cloncurry is situated in the north-western part of Queensland known as the Burke District, on the outer edge of the wide flood plain to the east of the Cloncurry river. Its exact location has been determined astronomically to be in lat. S. 20° 42′ 53″ and long. E. 140° 30′ 20·25″. Burketown and Normanton, the nearest ports, are distant 210 and 215 miles respectively in north-north-westerly and north-north-easterly directions. Townsville, through which most of the trade passes, is, in a direct line, 430 miles to the east-north-east; and Brisbane, the capital, is 900 miles to the south-east by east—in the opposite corner of the State.

The township is situated at no great distance south-easterly from the rolling downs, the strata forming which overlie and hide any lodes which may exist, and hence most of the mining developments have taken place westerly and southerly from the business centre.

Accessibility.

Cloncurry is connected by road with the ports of Normanton and Burketown, whose distances on the map are 240 and 235 miles respectively, and with the Great Northern railway branch termini Richmond and Winton, 183 and 220 miles respectively. The usual route followed by visitors on landing at Townsville is to train to Richmond, 307 miles, or alternatively to Winton, 368 miles, the starting points for coaches leaving twice a week for the field. The quickest way to reach the field from Brisbane is to rail direct to Longreach, and thence coach *viâ* Winton—the time required being five days.

The first section of the Richmond-Cloncurry railway is now under construction, and it is hoped that by the middle of this year it will be possible to rail to within 80 miles of Cloncurry (*i.e.*, to Gilliat), which will leave only one day's coaching.

The Duck Creek, Hampden, Mount Elliott and Duchess are the only mines directly on coach lines, and to reach the others private

* The author's advance notes on copper mining in the Cloncurry district were published in the annual report of the Under Secretary for Mines for 1906. A brief notice is there given of the form of the deposits and of the extent of the chief mines at the end of that year.

arrangements have to be made. Every group, and, with the exception of those at the Corella, almost every mine on the field, can be driven to, but in many cases a guide is necessary, as, owing to the slight traffic, the tracks are often indistinguishable. In other cases, such as Mount Oxide, it is preferable to ride across country to making the large detour necessary for the passage of a vehicle.

Extent.

The Cloncurry mineral field, as defined by proclamation in the "Government Gazette,"* has an area of 1,724 square miles, is very irregular in shape, and extends 20 miles north-east, 30 miles south-east, 60 miles south-west, and 25 miles north-west of the township. The proclaimed field, however, includes only a small proportion of the proved copper-bearing country, which reaches from lat. S. 19° 30′ to 22°, and from long. E. 139° to 141°. Thus Mount Oxide is 110 miles north-west and Mount Wheeler 25 miles south-east of Cloncurry; the Chatsworth mines are 75 miles south-south-west, and the Yelvertoft 100 miles west-north-west of Cloncurry.

Maps.

The maps hitherto published by the Lands Department include one on a scale of 2 miles to an inch (really a block map) and a later one (published in 1905) on a scale of 4 miles to an inch. The latter is a great improvement, showing as it does the main roads and having many corrections. The 2-mile sheet has also been published by the Mines Department, showing the leases in force at the time of preparation, but the map is now quite out of date, most of the leases having been repegged.

In the map published with the annual report of the Under Secretary for Mines for 1906 are indicated not only the roads travelled over by me, but also former roads, which may be opened again in the future, and are useful as an indication of the accessibility of the country. A considerable number of the leases having been surveyed, it was possible to locate them exactly, besides which all other leases in force at the end of the year are shown, with the principal reward claims and prospecting areas.†

Accompanying Part 2 of this report is a small-scale skeleton plan (a reduction of that just mentioned) showing the chief groups of mines and the geological boundaries.

An area of granite about 15 miles long and 10 miles wide should be shown between the heads of the Dugald River and Cabbage-tree and Palm-tree Creeks, having been so marked by Mr. Jack.

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* 1905, Vol. II., p. 441.

† This map is now available as G.S.Q. Publication No. 213.

Topography.

The topography of the Cloncurry district is striking enough to the casual observer, but to the geographer and geologist it has a special significance.

Stretching away for hundreds of miles to the north-east, east, and south-east are the famous rolling downs—vast blacksoil plains clothed with Mitchell and Flinders grasses, the only timber in any quantity, beyond an occasional emu-apple tree, being the lines of coolibah and ti-tree marking the course of a creek or river. The swelling of the surface would scarcely be noticed were it not for the variations in the extent of country within view at different points, the rise and fall being so slight, in fact, that the surface appears to rise in all directions from the observer whether he is in a hollow or on a rise.

The creeks have ill-defined channels, and even the rivers have eaten very little into the plain, which is now at base level, where stream action—as far as denudation is concerned—ceases. The tilted outcropping beds prove that the strata underlying the surface have already been subjected to some degree of denudation—to wit., in the removal of the upper portions of anticlines.

On leaving the downs one comes into a region of worn-down mountain forms, with scattered flat-topped hills, such as Soldier's Cap and Table Mountain. The latter are seen to be approximately equi-altitudinal, and they are undoubtedly the remnants of a former vast peneplain, whose average elevation above the rolling downs may be placed at 1,000 ft. This plain, or plateau, is now in its extreme old age, river valleys, carved out in it, having been widened until separated by only a narrow razor-back or even a row of hills. The prevailing north and south strike of the country has caused the ridges to have the same general alignment, but gaps are fairly frequent in the ranges, and numerous examples can be seen of stream piracy—the capture of the head waters of one stream by a branch from another stream on the opposite side of a range. A specially good example of this is that of the capture of the head of Cone Creek by Slaty Creek, at the Gorge, 20 miles south of Cloncurry. The larger valleys are flat bottomed, and their development is so extensive that we may consider them to mark the youth of a second peneplain near the base-level of the rolling downs.

As to the age of these various land forms, it seems most probable, from the geologic nature of the Cloncurry field, that the schist area is the site of a former mountain tract of some altitude, and that it was from the wearing down of the mountains that the constituents of the strata forming the Rolling Downs (Lower Cretaceous) strata were derived. Part of the Desert Sandstone may also have been formed from the wearing down of the mountain tract, the difference in the petrological character of the two series being due to a changed climate, affording different products of decomposition and to different conditions of deposition (lacustrine as against marine).

The base level of the old plain formed in Cretaceous times was in all probability that of the present rolling downs surface, and incidentally the Desert Sandstone mesas are therefore evidence of elevation of the schist area over which they are scattered. Stream action would again commence after the upheaval with the production first of valleys, then of a peneplain, and ultimately the reduction of the plateau to a plain just above sea-level would be completed. The valleys having been carved out of rocks including some of Desert Sandstone (?) age* they themselves are of necessity younger than Cretaceous; but beyond that no data are to hand to more definitely place them.

The importance of the Cretaceous peneplain and present valley development in connection with the genesis of the Cloncurry ore deposits will be referred to later under the general description of the ore deposits.

[*L. C. B., photo.*

FIG. 1.—WHITE GORGE, PROSPECTOR CREEK, VIEWED FROM THE EAST.

The drainage of the country affords interesting studies. The general trend of the strata being north and south, the silicification of certain beds has induced the production of north and south valleys, several miles in length—Prospector Creek, Middle Creek, Miranda Creek, and the upper Leichhardt River being examples—separated by razorbacks and lines of hogbacks. These hogbacks are due to piratical lateral branches of the drainage channels, cutting back across the divides, with the production of narrow gorges and the cutting off of head waters of adjacent drainage areas. The range west of Prospector Creek has in this manner been trenched in several places, and the drainage of an extensive valley has thus been diverted

* It is to be noted that there is no direct evidence, other than petrological, that the Cloncurry mesas are of Desert Sandstone age, except their occurrence as outliers of the proved plateaux to the south-east.

into Prospector Creek. The White Gorge is a notch, 150 ft. deep, cut in a range owing its existence to a rib of quartz-veined, silicified slate, between 30 and 40 ft. in thickness. A notable feature of the gorges is that there is generally a fine pool of water below the rock-bar, which is in process of being cut through. These pools have been often for months the sole supply of water for miners in the vicinity. The holes are produced by the scouring action of the stream falling from the bar in time of flood, and it is probable that the supply of water is augmented to some extent by seepage from the slates adjacent to the silicified rock.

[*L. C. B., photo.*

FIG. 2.—WHITE GORGE, PROSPECTOR CREEK, VIEWED FROM THE NORTH.

The south-western branch of the Six Mile (Leichhardt) Creek occupies one of the few transverse valleys seen in the Cloncurry district. The stream would, therefore, appear to be consequent—the uplifting of the country at its head having produced abundant fall and capacity for stream action. McKean's Gorge forms the exit of the valley at the lower end, and is characteristic, the stream, owing to silicification of a certain band of country, having been able to cut out only a narrow passage since the hardened rock was encountered.

When viewed from one of the higher mountains, such as Mount Bornite, which rises 380 ft. above Six-mile Creek, the region is plainly seen to be a dissected plateau, flat-topped remnants being best preserved to the south-west of Mount Cuthbert, while to the north-east and east erosion has reduced the ranges to rows of sugar-loafs, separated by wide flat-bottomed valleys, like that of the eastern branch of Six-mile and Copper-mine Creeks.

The existence of a peneplain at the head of the Cloncurry River is indicated by the flat-topped hills and ridges between Mount Elliott and Devoncourt station.

Population.

It is difficult to arrive at any reliable estimation of the population of even the township, owing to the large floating element. Sub-Inspector Quilter, at the end of 1906, placed the total population of the whole district—say 80 miles radius from the township—at 2,000; and that of the township and within 10 miles radius at 800. The Warden, however, estimates the total population at only 1,089.*

Climate.

The climate of the Cloncurry district is reported to be all that could be desired during the winter months, but from the beginning of October to the end of March it can only be described as trying in the extreme—the temperature varying between 55° and 115° Fahr. Thus in October last the maximum and minimum readings† were 103·1° and 53·8°; in November 104·8° and 62·4°; in December 104·3° and 60°; and in January 107·3° and 70·2°. As a general rule thunder storms do not appear till the end of December or the beginning of January, the rainy season setting in towards the end of the latter month, and lasting till the end of March. Prior to the advent of the thunder storms the heat, owing to the dryness of the atmosphere, is not as unbearable as might be expected, 80° or 90° on the coast causing a greater bodily exhaustion than 100° here, and further relief is afforded by the coolness of the nights, which is also due to the dryness of the air.

It stands to reason that in such a climate the same amount of work cannot be expected from men as in the more temperate zones. Miners working their own claims do so in a very leisurely manner, and it is becoming a general practice to spell near midday for a couple of hours. While travelling it is also found advisable for the horses' sake, to spell during the heat of the day, much better results being thereby secured.

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* Annual Report of the Under Secretary for Mines for 1906.

† Recorded by Mr. O'Hagen, of the Post Office, Cloncurry.

GENERAL LITERATURE.

(1) Reports on the *Cloncurry District*, by the Wardens in the Annual Reports of the Under Secretary for Mines and in the "Q.G.M. Journal."

(*a*) Reginald C. H. Uhr	1878 to 1885.
(*b*) C. D. Keane	1886
(*c*) W. Samwell	1887 to 1888
(*d*) John D. Gibson	1889 to 1891
(*e*) Richd. Riley	1892 to 1894
(*f*) T. H. Boddington	1895 to 1897
(*g*) Wm. W. Alder	1898
(*h*) J. C. Linedale	1899
(*i*) Jas. Bracewell	1900 to 1902.
(*j*) F. J. Cherry	1903 to 1906
(*k*) J. C. Linedale	1906 & 1907.

While these reports have been very useful in compiling the output and working up the history of the field, there are unfortunately many breaks, and as no uniform method of reporting returns has been in force, it is impossible to obtain from this source a complete record of the output of the different mines of the field.

(2) Six reports on *the geological features of part of the district to be traversed by the proposed transcontinental railway.* By Robert L. Jack, Govt. Geologist. Bris.; By Auth.: 1898. No. 136 (reprint of No. 10 published in 1885) of the Geological Survey Publications.

Descriptions of lead deposits at the Dugald, iron at Mount Leviathan, and gold at the Gilded Rose, Top Camp, Tip Top, and Pumpkin Gully will be found in this report besides accounts of copper deposits on the Dugald, at the Great Australian, Mt. Douglas, and Pumpkin Gully, Slaty Creek, Duck Creek, Argylla, Crusader and Dobbyn, and Mountain Home.

(3) Report on *the Leichhardt Goldfield and other mining centres in the Cloncurry District.* By William H. Rands, Assist. Govt. Geologist. Bris.; By Auth.: 1895. G.S.Q. Publication No. 104.

Full particulars of developments at the Bowerbird (Leichhardt), Gilded Rose, Soldier's Cap, Pumpkin Gully, Top Camp, Last Call, Bell's Camp, and Tip Top (Agate Downs).

(4) *Recent Developments in the Copper-Mining Industry in the Cloncurry District.* By Walter E. Cameron, B.A., Assistant Govt. Geologist. Bris.: By Auth.: 1900. G.S.Q. Publication No. 153.

Including general geology and descriptions of the Great Australian, Hampden, Chinaman, Mount Elliott, Mount Oxide, Coolullah, and Crusader lodes and the Pilgrim Creek, Pumpkin Gully, Dugald River and Palmtree Creek leases.

(5.) Report on the *Hampden Mines.* By John Godkin, manager. 1901.

Not available.

(6) Report on the *Hampden Copper Mines.* By F. Stanley Low, B.C.E., late manager. Dec., 1900. Published in the prospectus of the Hampden Cloncurry Copper Mines, Ltd. (See below.)

(7) "*Copy of report on the principal Copper Properties at Cloncurry,*" North Queensland. By W. P. Rutherford, Jnr., A.R.S.M., A.Inst.M.M., and Mr. Kitchener (Brother of Lord Kitchener). July, 1904. Lon.: Morton and Birt.

The report is almost without exception condemnatory.

(8) *The Cloncurry Copperfield, Queensland.* Special report on its ores by Thomas Gibb, A.R.S.M. "Q.G.M., Jour.," Nov., 1904.

"The ores from the point of view of their metallurgical treatment, with local condition of economical bearing." The deposits referred to are those at Slaty Creek, Duck Creek, Malbon River, and at Hampden.

(9) Report on *the Hampden Mine.* By A. E. Savage, Resident Manager of the Australian Smelting Corporation, Ltd. Feb., 1906. Published in the prospectus of the Hampden Cloncurry Copper Mines, Ltd. (See below.)

(10) Report on *the Mount Elliott Mine,* Cloncurry. By G. A. Waller, one of the Directors. June, 1906. "Walsh and Tinaroo Miner." (See below.)

(11) *With the Premier,* a series of articles by C.A.B., in the Brisbane "Courier" during June, 1906.

Chiefly historical.

(12) Report on *Mr. John Moffat's Options at Cloncurry.* By G. A. Waller. Aug., '06.

The Wee MacGregor, Mt. Wheeler, Ivanhoe, and Dugald River groups are herein described.

(13) Report upon *the properties of the Queensland Exploration Co., Ltd.* By Messrs. Alexander Hill and Stewart. Oct., 1906. Accompanying report by the Secretary of the Company, dated 6th Dec., 1906.

This report refers to the Great Australia and the Ralston or Lady Leases.

(14) Report on the *Mount Elliott Mine,* Cloncurry. By G. A. Waller, Gen. Manager. Jan., 1907. Accompanying Directors' report for 1906. (See below.)

(16) *The Cloncurry Field.* By Randolph Bedford, in the Sydney "Daily Telegraph," April, 1907.

A somewhat highly coloured, but very interesting, account of developments during 1906.

HISTORY.

1870.—Messrs. Henry Sheaffe and McPhail were among the best known of the early copper prospectors in this district, much of their work having been done prior to 1870. They first took up many mineral selections under the Mineral Act of 1872, and converted most of them into freeholds.

1880.—The first official Cloncurry report available to me, written in 1880, refers to the securing of many lodes at Duck Creek, Fisher's Creek, the Williams, Dugald, and the Leichhardt Rivers. At about this time an English syndicate made a proposal to build a transcontinental railway, passing through the Cloncurry District, but failed to obtain Parliamentary sanction.

1881.—Additional discoveries were made in 1881, but the prospectors were "debarred from securing the land" (Warden Uhr). Mr. (now Dr.) Robert L. Jack, Government Geologist, made a geological examination of the field in this year, in conjunction with the Transcontinental Railway Survey Party under the direction of Major-General the Hon. W. Fielding.

1882.—There was no official information from the field in 1882 and 1883, but a report by Mr. Geo. Phillips on a railway from Cloncurry to Normanton was published.

1884.—The first mining leases were granted by Warden Uhr in January, 1884—the Eureka and United copper lodes in the Hampden district, the Lady Musgrave and Cave Hill in the Pilgrim Creek district, and the Ironclad at the Florence River. In the same year the Great Australia Company began operations, and during the following three years smelted locally the ore raised, but in 1889 closed the mine down, allegedly because of the low price of copper.

1886.—In 1886 the plans for the Cloncurry-Normanton line were adopted by Parliament, but construction was not begun, and the grant was transferred to the Croydon line.

1890.—The year 1890 was marked by several discoveries by Henry in the Leichhardt River district, but then for seven years nothing was done, owing to the low price of the metal.

1898.—Prospecting again became the order of the day, especially at Pumpkin Gully and at the Hampden, after the passing of the present Mining Act in 1898. At the latter place a Melbourne syndicate, during this and the following year, energetically carried out the prospecting of the reward claim.

1899.—A great many mineral areas were applied for, but very little work was done on any of them.

1900.—Option syndicates were formed to test Mount Elliott and Mount Cuthbert.

1901.—Work ceased at Hampden and Mount Elliott, and little was being done elsewhere, owing to the low price of copper. Parliament in 1901 passed a Bill authorising the construction of the Cloncurry-Normanton Railway by private enterprise, but the syndicate concerned made no move, and its deposit of £10,000 was forfeited in January, 1906, after the Government had decided to continue the Richmond line.

1902.—Drought retarded operations.

1903.—The Goldfields of Matabeleland, Ltd., negotiated for the purchase of Duck Creek leases. The chief work done was at the Hampden, Duck Creek, and Coolullah Mines, but the quantity was inconsiderable, because of uncertainty as to the intentions of the railway company.

1904.—There was considerable activity all over the field, owing to a good season.

1905.—Drought. The chief events were the sale and the opening up of Mount Elliott. Work was also begun on the Willcocks Cloncurry Copper Syndicate's properties at Duck Creek.

1906.—The high prices ruling for copper during this year caused unusual activity in prospecting and mining. Towards the latter part of the year several companies were formed to develop certain of the deposits, but at the present time there is a lull in the excitement until definite results have been obtained.

MINERAL HOLDINGS.*

Mineral lands are now held in the Cloncurry District as freehold, as leasehold, as claims, and as prospecting areas. The freeholds were taken up under the Mineral Lands Act of 1872, and are now held absolutely without conditions. Many of them have been so long deserted that there is much doubt as to their exact location, and the Mines Department has, therefore, undertaken to resurvey and remark the whole of them, primarily for the benefit of prospectors who desire to mark out claims without encroaching on freehold ground.

Mineral leases are held from the Crown under a yearly rent of 10s. per acre, and are subject to the condition requiring the employment of one man for every 10 acres or fraction of the same, unless exemption has been granted.

Ordinary mineral claims may be taken up by holders of miner's rights and retained subject to the continuous employment of one man for every 200 ft. in length.

The area of a prospecting area varies from 10 acres if within a mineral field, and not less than 1 mile from a working mine, to 160 acres if without the limits of a mineral field, the labour conditions requiring the holding to be continuously worked by one man. Registration has to be renewed monthly.

* See the Mining Act of 1898 and Regulations. By Authority. Brisbane.

ECONOMICS.

Total Production.

The figures given below have been taken from the annual reports of the Under Secretary for Mines, the returns for years prior to 1898 being unavailable:—

1898	5	tons ore, valued at	£112	
1899	2	,, ,,	£145	
1900	13	,, ,,	£780	
1901	236	,, ,,	£14,868	
1902	51	,, ,,	£2,550	
1903	148	,, ,,	£8,584	
1904	1,336 5/20	,, (30 %) ,,	£23,560 0 9	
1905	1,521 17/20	,, ,,	£32,876 14 4	
1906	2,524 19/20	,, ,,		
1907	1,924 6/20 [1]	,, (30 %) ,,		

[1] Including 597 tons smelted at the Great Australia.

Monthly outputs during the year 1907[2] were as follow:—

	Tons.		Tons.
January	92·20	July	354·00
February ...	117·30	August	111·00
March	104·55	September ...	85·78
April	64·00	October	109·70
May	98·60	November ...	525·65 [2]
June	164·50	December ...	97·00 [3]
			1,924·28

[2] Compiled from the Warden's monthly reports.
[3] Smelted at the Great Australia.

Costs.

The ore hitherto exported has, it is believed, contained an average of 30 per cent. copper. Very little running under 20 per cent. has been sent away, as claim-holders in this part expect, on account of the roughness of the life, much more than would be considered good wages in the settled areas.

The following statements of cost are approximate, but will give an idea of the difference caused by the completion of the railway connecting Cloncurry with Townsville:—

	£	s.	d.	
Cartage from mine to Richmond	8	0	0	per ton
Railage, Richmond to Townsville	0	17	6	,,
Wharfage, etc.	0	2	0	,,
Freight, Townsville to Newcastle	0	11	0	,,
Treatment (uniform charge)	1	16	6	,,
,, (1s. per unit, 30%)	1	10	0	,,
	£13	17	0	

Cartage from mine to Cloncurry	2	10	0	per ton
Railage, Cloncurry to Townsville	1	4	6	,,
Wharfage, etc.	0	2	0	,,
Freight, Townsville to Newcastle	0	11	0	,,
Treatment (uniform charge)	1	16	6	,,
,, (1s. per unit, 20%)	1	0	0	,,
	£7	17	6	

Mining costs may vary from 10s. per ton upwards, and the other expenses being practically constant, they naturally determine the amount of profit. The bunchy occurrence of the ore necessitates much dead work, and, though the cost of sinking or driving per foot may be comparatively low, the expenditure per ton of shipping ore is always high.

Transport.

Most of the transport is by horse team drawing heavy four-wheeled wagons. Early in 1906 carriage from Mount Elliott to Richmond (240 miles) cost £4 10s. per ton; by the middle of the

[*Photo., L.C.B.*

FIG. 3.—HORSE-TEAM DRAWING ORE OVER THE DOWNS BETWEEN CLONCURRY AND RICHMOND.

year it had increased to £6 10s., and at the end stood at £8 10s., this being due to teams being unable to cope with increased requirements following on the general opening up of the district and the approach of the wet season. It has now been decided to connect the mine by rail with the railway terminus at Cloncurry.

In December, 1906, carriers were demanding £8 per ton to carry ore from the Crusader Group to Normanton, a distance of 80 miles, which works out at 2s. per mile.

Towards Christmas, 1906, freights rose rapidly; £8 per ton was paid from the Gorge to Winton, a three-weeks' trip for wagons carrying on the average 6 tons (5 to 8 tons). Expectation of the advent of the wet season induced shippers to offer a bonus of £2 per ton if delivery was made within 8 weeks, and £4 per ton if within 6 weeks.

During November, 1906, £8 10s. per ton was paid for conveyance, per camel, of ore from Prospector Creek to Richmond, and £8 per ton

was offered unsuccessfully to teamsters for the Normanton route, then liable to flooding, and besides in a poor state for horse-feed, though there was abundant camel-feed (giddia, salt-bush, emu-apple, needle-bush, blue-bush, and dry roley-poley).

The miners look upon the camels as a boon, in that their competition has kept the demands of teamsters within reasonable limits.

Towards the end of 1906 camel teams were carrying ore from Cloncurry to Richmond for £5 per ton, with coke back-loading for £4, while teamsters charged £6 per ton forward and £5 10s. per ton back. Camels carry 12 or 14 cwt., and travel at an average rate of 2 miles an hour, 30 in a string.

[*Photo., L.C.B.*

FIG. 4.—THE ARRIVAL OF PROVISIONS AT CLONCURRY FROM THE COAST.

It is understood that, in the latter part of 1907, a contract was let by Mr. Henry for the conveyance by camel of 1,000 tons of ore from Mount Oxide to Burketown, at £10 per ton.

The miners on St. Paul's Creek and the Leichhardt generally were experiencing difficulty in getting their ore to the seaboard. The reported appearance of poison-bush towards Normanton has deterred the camel-drivers, and the prospect of floods during the coming rainy season has compelled teamsters to refuse £7 and £8 per ton, the distance to Normanton by road being 170 to 180 miles.

Companies.

The information given below, concerning companies operating in the district at the beginning of 1907, has been compiled from various sources.

Celestial Copper and Option Company, Ltd.
Cap.—£5,000. £10 shares.
Prop.—Celestial, Speculation, and Horseshoe.

Cloncurry Copper and Gold Exploration Company, Ltd. (Mgr.: Hockings.)
Cap.—£50,000. 5s. shares.

Cloncurry Exploration Syndicate, Ltd.
Cap.—£7,000. £1 shares. (Floated January, 1907.)

Cloncurry Railway Company.
Prop.—Regina, &c.

Cloncurry Syndicate, Ltd.
Cap.—£50,000. £1 shares. (Floated June, 1906.)
Prop.—Formerly held Ralston leases.

Daisy United Copper Mines Company, No Liability.
Cap.—£30,000. 5s. shares. (Floated January, 1907.)
Prop.—Daisy United, &c.

Federal Reward Copper Company, Ltd.
Cap.—£25,000. 10s. shares.
Prop.—Federal R. C., Mackinlay, Kingfisher, Weatherl, Lady Norma, Elder Bornite.

Hampden-Cloncurry Copper Mines, Ltd. (Gen. Mgr.: C. L. Smith.)
Cap.—£300,000. £1 shares. (Floated March, 1906, and capital increased March, 1907.)
Prop.—Hampden-Duchess Copper Mines, and Tip Top Gold Mines.

Hampden Copper Mines, No Liability. (Gen. Mgr.: C. L. Smith.)
Formerly held Hampden and Duchess Mines.

Lady Fanny. (Option syndicate.)
Cap.—
Prop.—(Lady Fanny Mine).

Leichhardt-Cloncurry Company. (Mgr.: Peberdy.)
Cap.—£62,500. £25 shares. (Floated 1906.)
Prop.—Ivanhoe, Pilgrim, Mount Wheeler, Magnet, Mavis, Una, Native Companion. Interest held in the Wee MacGregor Cloncurry Copper Mines, Ltd.

Melbourne-Cloncurry Prospecting Company.
Cap.—£6,000. £10 shares.

Monakoff Company.
Prop.—Monakoff Mine.

Mountain Home Copper Company.
Prop.—Mountain Home.

Mount Cuthbert, No Liability.
Cap.—£240,000. £1 shares. (Floated January, 1907.)

Mount Cuthbert Copper Development Company, Ltd.
Cap.—£37,000. £25 shares. (Floated January, 1907.)
Prop.—Mount Cuthbert Mine, &c.

Mount Elliott, Ltd.
Cap.—£750,000. £5 shares. (Floated 1906. Reconstituted June, 1907.)
Prop.—Mount Elliott, &c.

Mount Hope Copper Mines, No Liability.
Cap.—£50,000. 10s. shares. (Floated March, 1907.)
Prop.—Mount Hope.

Mount Merlin Copper Company.
Prop.—Mount Devoncourt and Horse Creek.

New Cloncurry Copper and Smelting Company, Ltd.
Cap.—£3,300. 6s. shares. (Floated October, 1895.)
Prop.—Interest in North Queensland Railway Company, Ltd., and in Queensland Exploration Company.

North Queensland Exploration Company. (Mgr.: Thompson.)
Cap.—£5,000. 10s. shares.
Prop.—Mount Lloyd, Ready Rhino, Junction, Forget-Me-Not.

North Queensland Railway Company, Ltd.

Queensland Copper Freeholds, Ltd.
Cap.—£300,000. £1 shares. (Floated January, 1907.)
Prop.—Malbon, Argylla, Rainbow, Chinaman, Diagonal, Yamamilla, Crusader, and Dobbyn. One-third interest in Mountain Home Copper Company.

Queensland Exploration Company, Ltd. (Mgr.: G. E. Moore.)
Cap.—£200,000. £1 shares. (Floated January, 1906.)
Prop.—Freeholds adjoining Cloncurry and Lady leases.

Wee MacGregor Cloncurry Copper Mines, Ltd.
Cap.—£300,000. 10s. shares.
Prop.—Wee MacGregor, Walleroo, Wattle, Central, &c.

West Cloncurry Copper, Ltd. (Mgr.: Hogarth.)
Cap.—£32,000. 10s. shares.
Prop.—Argylla West (Springs Peaks, Snowstorm, Fuschia, Feather-top, Mount McCabe), Blocks 15, South, and 9, and Central Hampden

Willcocks Cloncurry Development Syndicate. (Mgr.: Matheson.)
Cap.—£112,000. £1 shares.
Prop.—Timberoo, Cornet, Hilda, Comet, Woomera, Belfast, Tharsis, Noontide, Alabama, Pioneer, Huggin's Look-out-and-in. Eva, Jessie, Melba, Secret, Rosebud, Rosewood, Inquiry.

Treatment.

With the exception of the short life (1884 to 1889) of the first Great Australia furnaces, no attempt had been made to treat the ores of Cloncurry locally until 1907. Early in that year an attempt was made to treat the ores in a reverberatory furnace at Slaty Creek, but after a very short run it closed down, Mr. Mort, the metallurgist, informed me, because of insufficient stocks of ore. Later, the Queensland Exploration Company commenced smelting with two blast furnaces, and before the end of the year put through 597 tons. The Willcocks Cloncurry Development Company has completed a blast furnace of an estimated capacity of 90 tons a day, but this has not yet been blown in. The Mount Elliott Company is understood to also be contemplating the installation of a smelting plant at their mine.

Local smelting is handicapped in the first place by the great scarcity of fuel, coke having now to be brought from the seaboard, though the first small smelters managed to carry on with charcoal made from the scanty timber of the neighbourhood. A reverberatory was erected at Slaty Creek, on the assumption that it could be more cheaply worked depending on local timber than a modern blast furnace depending on coke. The scarcity of water during the greater part of the year is also against successful treatment on the spot, but this could probably be overcome by the construction of storage reservoirs.

GEOLOGY.

General.

The rocks in which the copper has been found have been referred to as "the older metamorphic series . . . . . mapped as of Silurian Age, and consisting mainly of steeply inclined—as a rule almost vertical—beds of altered sedimentary strata, being made up chiefly of quartzites, greywackes, slates, schists, and crystalline limestones."*

The evidence† for referring the beds to the Silurian system consists in the identification, by R. Etheridge, junr., of certain fossils from the Cairns Range, at the head of the Georgina River, including (1) *orthoceratites*, sp. ind., (2) *actinoceras* (beaded siphuncle of) sp. ind., and (3) univalve and bivalve (casts and impressions).

Mr. Cameron noticed that west of the West Leichhardt Telegraph Station, and also west from Fiery Creek, the beds are less metamorphosed, while the lead veins of Mended Hill occur in evenly and closely bedded alternating sandstones and shales, showing little metamorphism, and dipping at comparatively low angles at the west. Dr. Jack has lately told me that he has been able to trace a gradual change from copper-bearing schists in the Cloncurry District to lead-bearing shales in the Lawn Hill. I myself noticed that metamorphism is less intense in Gunpowder Creek catchment. Metamorphism has been so intense and the study of the district so hurried and superficial that it cannot be aserted with any authority that the strata of this vast district are of one age, and the occurrence of Silurian fossils in the Cairns Range is insufficient evidence for the classifying of the whole district as Silurian.

Mr. Rutherford speaks thus of the general geological features of the field:

> The geology of the field is of particular interest, helping in great measure in the determination of the mode of occurrence of the ore. Essentially the country is composed of rocks of sedimentary origin, consisting of sandstones, limestones, schists, and slates, broken through in places by mases of igneous rocks, principally granite. The sedimentary rocks are all classed on the geological map as of silurian date. I consider, however, that the sandstone and limestone are of more recent date than the schists and slates, on which they lie unconformably, and consider this fact of importance. These rocks are usually much metamorphosed and tilted to a high degree. The sandstones, though usually vertical or nearly so, are seen at all angles, to horizontal in places; they occur in all stages of metamorphism from the soft, friable variety to indurated quartzite. This quartzite is the dominant feature of the whole country, usually forming the crests of the hills and standing out as bold ranges. It is remarkable for the distribution over the whole metalliferous field.

With regard to the above, it goes without saying that if the sandstone and limestones unconformably overlie the schists and slates

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* Recent Developments in the Copper Mining Industry in the Cloncurry District. By Walter E. Cameron, B.A., Assistant Government Geologist. Bris. By Auth.

† Ann. Prog. Rep. of Walter E. Cameron, Assistant Government Geologist, for the year 1900.

they must be newer, but during my examination no case of unconformability was found, omitting, of course, Rolling Downs limestone and Desert Sandstone, both of Cretaceous age, flat-bedded, and nowhere cupriferous. Mr. Rutherford states that the "sandstones" are usually vertical, or nearly so, and it is difficult to comprehend how they could then be unconformable to the underlying (?) or nearly vertical schists. As a matter of fact, both quartzite and limestone are interbedded with the schists, as careful examination of almost any of the crops and workings will show.

In concluding his report, Mr. Rutherford refers again to the distribution of the ores:

> As an impregnation (usually in the form of green carbonate) of the metamorphosed sandstone which occurs almost all over the field, forming the hills and ranges. I consider that the copper was laid down from solution about the same time as the sandstone, and that, since this strata has been metamorphosed and tilted up, the copper has been leached out by percolating water, and has re-deposited along lines of stratification of the rock, usually near beds of quartzite, percolation being easiest between the bedding of this and the adjoining sandstone.

The idea of contemporaneous deposition of copper and sediment was first proposed for the Kupperschiefer (copper shales) of Mansfeld, Saxony, where the ore occurs in thin leaves lying between laminæ of slate. It has now been proved that the shales, sandstones, and limestones have been rendered cupriferous owing to extensive faulting long subsequently to their deposition (as shown by Prof. Franz Posepny). The precipitation of copper with sand is most improbable, but, even if the sandstone had been rendered cupriferous in any way, and indurated, as Mr. Rutherford says, it would then be almost an impossibility to leach it out.

I have been unable to find any justification for Mr. Rutherford's conclusions. The quartzites are of several types, but all are interbedded with the schists. Some of them undoubtedly represent altered beds of sandstone, but the majority of them are segregation deposits formed during the metamorphism of the country, especially along crush-zones. In any case they mark lines of weakness, which have been taken advantage of by copper-bearing solution, and their present cupriferous character is due to permeation by those solutions.

Slates.

Massive and thick-bedded but not fissile slates were noted in several parts, but they are all highly altered, except in the vicinity of Mount Oxide, where they are thin bedded and only slightly indurated. They are, like the schists, steeply tilted, and they strike between north-east and north-west, generally within 20° of north. About Fisher's Creek and the 18-Mile Hotel metamorphism has been less intense than in any other part of the Cloncurry district, and stratification can with little difficulty be distinguished, with the fossiliferous nature of the interbedded limestones.

Limestones.

Limestones, typically lenticular and interbedded with slates or schists, occur at the Duchess and Ivanhoe, Pilgrim, Dandy, Slaty Creek, Mount Wheeler, Pumpkin Gully, Township, Dugald River, Prospector Creek, Mount Bornite, &c.

At Pumpkin Gully the rock shows indistinct traces of a lamellar *Stromatopora*, and on Prospector Creek it is thin-bedded and almost certainly of sedimentary origin. At the other places, however, the rock is highly altered, and in some cases the calcium carbonate may have been leached from the sheared rocks and precipitated chemically in the more open zones. In many places—as, for example, Mount Wheeler and Duck Creek—it is of a very ferruginous character, and at Mount Bornite really approaches ankerite in composition.

The limestones are often accompanied by copper ores, more especially cuprite and native copper, the latter being scarcely ever found except in the vicinity of outcrops of that rock. In these cases the limestone has generally suffered replacement by silica to a greater or less extent, the product being a yellow jasper or impure chalcedony.

Schists.

These rocks show little variety in their macroscopic characters, and in the field most of them are referred to as chloritic or sericitic schist. They are the most noticeable of all the rocks of the district, for the reason that they have been most generally produced in the vicinity of the ore-bearing shear-zones, owing to the movements that have there taken place.

The lamination of the schists in most cases would appear, though not without some doubt, to approximately agree with the original stratification of the country, the chief exceptions being on Duck Creek, where shearing has taken place, producing schistosity running almost at right angles to the plane of bedding. In only a few cases was it possible to single out an outcrop having some predominating mineral such as hornblende. The occurrences of sporadic crystals of secondary minerals is exceedingly rare, taking the field as a whole, the only notable case being that of the staurolites in the wide flat-bottom valley of Cattle Creek (in the Corella catchment area), which is bounded on the east by the almost completely dissected Wee MacGregor Range, and on the west by an only slightly dissected plateau, separating it from the valley of the Corella. These ranges, presumably, formerly were part of a peneplain about 1,000 ft. above Cattle Creek. In the eastern part of the valley the developments of the crystals has been imperfect, "spotted schists" being there found gradually fading into chloritic schist. Westwards, however, dark-brown, almost black, and nearly opaque staurolite crystals are exceedingly plentiful. They are $\frac{1}{10}$ to $\frac{1}{5}$ in. in diameter, and $\frac{1}{4}$ to $\frac{1}{2}$ in.

in length; most of them are twinned in cruciform and stellate forms, showing basal plane and brachypinacoid combined with the simple prism. Interspersed with the staurolite crystals are brown and pink dodecahedra of garnet, about $\frac{1}{20}$ in. in diameter.

The schists mark the site of a worn-down mountain region, or one from which an amount of material equivalent to a mountain mass has been removed. The granites are not found in the Cretaceous areas, and their intrusion must, therefore, have occurred previously to the opening of the Cretaceous period. The occurrence of extensive areas of granite is, however, proof of the removal by denudation of great thicknesses of formerly overlying rock.

The schists in north-western Queensland alone cover an area extending 400 miles from north to south, and 100 (50 to 200) miles from east to west, while the Cretaceous beds which continue southwards into New South Wales, occur over a width of 300 (from 200 to 400 miles). Assuming that one-half the Cretaceous sediments (*i.e.*, over a zone 150 miles wide) were derived from the old north and south range, and that the average thickness of the sediments is 1,500 ft., it may be calculated that the schist range must have had an average elevation of 3,600 ft. The removal of this mass must have caused a rise of the isogeotherms, but the release of pressure being so gradual, the only eruptive manifestations were the giving off of residual gases and solutions, from which were formed the pegmatites, and possibly in part the ore-bodies.

The Coppermine-St. Paul's Creeks, Donaldson, and Duck Creeks belts are similar, though the country of the first is less schistose, and is characterised by the great development of a brown porphyry. This is sometimes schistose, and at others much altered, when it much resembles greywacke. The occurrence of blows of quartz and the distribution of bunches of ore in schist is the same, but the ore-bodies are more ferruginous on the northern belt, and there is some likelihood of the ore-bodies being more permanent, while the shoots of ore are longer, though not so rich. In these belts schistosity has been produced, chiefly along crush- or shear-zones.

In some parts—*e.g.*, west of Prospector Creek and south of Six-mile Creek (Leichhardt River)—wide areas have been rendered uniformly schistose, and ore-deposits are there conspicuously wanting, presumably owing to the absence of well-marked fracture-zones.

Gneissoids.

Between the Lady Fanny and Mount Hope Groups a series of dark-coloured gneissic rocks, in which the separation of the felspar, quartz, and ferro-magnesian minerals into bands has taken place, was noticed. The Little Beauty ore deposits occur in this rock, a product of dynamic metamorphism.

Quartzites.

Blows of granular quartz, often referred to as quartzite, are among the most prominent features of the schist areas. This quartz may have segregated from the country rock during the metamorphism, or may have been introduced from deeper-seated regions subsequently to the metamorphism, or the quartz bodies may have been produced in both ways in different parts. The quartz in the crush-zones of Duck Creek may be taken as due to segregation, while the "blows" of Mount Hope may be considered as due to intrusive after effects. As has elsewhere been stated, the pegmatite dykes of Mount Hope are evidence of pneumatolysis having been effective in that locality.

Granite.

The granite areas in the district covered are five in number—all, except the northernmost, which is granite—porphyry, typical quartz-orthoclase-biotite rock.

There is one on the divide between the Florence River and the Cloncurry River to the south; another stretches from Table Mountain to beyond the Mavis Mine; a third (inadvertently omitted from the plan accompanying this report), lies between the heads of Prospector Creek and the Dugald River; the fourth lies to the west of the upper part of St. Paul's Creek; and the fifth extends southwards from the lower part of Gunpowder Creek, across Mistake Creek, almost to Surprise Creek.

No attempt was made to map-in the boundaries of these areas, but all of them except one were traversed in travelling between the mines. There appears to be no doubt, however, as to their having intruded the schists. The outcrops would, in fact, appear to be the uppermost peaks of a batholith underlying Cloncurry, of the existence of which there is abundant evidence in the very commonly occurring and generally schorl-bearing pegmatites at the head of the Burke River, at the head of Duck Creek, to the north of Soldier's Cap, on the flanks of Table Mountain, on the main road a few miles east of Quamby, on the Camooweal road falling to Prospector Creek, and in the vicinity of the Eclipse group of mines to the north of Donaldson. It further seems very likely that the intrusion of the magma was the cause of the primary concentration of the Cloncurry ores, for copious pneumatolitic solutions would then be given off, and would find an easy passage through the overlying schists, dissolving copper from the more basic rocks, and precipitating it either above or at greater distances from the hot magma.

The cap of Table Mountain is formed of two beds, say, 20 ft. in thickness, of a silicified felspathic sandstone, presumably of Upper Cretaceous age. The greater part of the mountain, which rises at least 200 ft. above the flats, is slate containing large irregular bunches

of quartz, but the basal part is a brownish micaceous quartzite, irregularly veined in all directions by pegmatite. These veins often have a comb-in-comb structure, owing to abundant schorl having crystallised at right angles to the containing walls. Many of the dykes are only faintly demarked from the quartzites, and crystals of felspar were noticed in the latter several inches from the dyke.

Tournalinisation, due to deep-seated intrusions of igneous magmas, is not wanting on Slaty Creek and towards the head of Duck Creek, as well as surrounding the granitic area, which stretches from Cloncurry to the Dugald River. Pegmatitic veins are especially abundant in the flanks of Table Mountain.

While it is likely that most of the quartz of the crush-zones segregated from the country rock during its metamorphism, the probability of some of the silica having been given off pneumatolytically from the granitic magma is not to be overlooked.

Porphyry.

Porphyry, more or less schistose and altered, occurs in quantity in many parts of the district, and abundantly in the vicinity of the Lady Fanny, Monitor, Just-in-Time, Mount Cuthbert, Crusader, Dobbyn, Bull Creek, and Eclipse groups. These were mistaken in the field for highly altered sedimentaries, being mostly somewhat schistose, while the phenocrysts, as a rule, are not sharply defined macroscopically from the ground mass. Microscopic examination, however, proves their igneous nature—at least in the case of rocks from the Dobbyn and Bull Creek groups, which were the only ones of which sections could be obtained. From the occurrence of the rock it is likely that it is an extrusive, and that it is interbedded with the sedimentaries in which it is found.

The occurrence of copper ores in the rock in the Lady Fanny group, the locus of its greatest development, is of much interest, because of immense low-grade impregnations of porphry in the United States, where, however, there is an important difference, in that the rocks have suffered decomposition allowing of the downward leaching of the copper.

Dyke Rocks.

Diorite was recognised in several places—Hampden, Duck Creek, Slaty Creek, Argylla, St. Paul's, Copper-mine Creek, and Bull Creek. The occurrences seemed generally to be in the form of bosses, but in no case was there an opportunity to define its extent.

Besides the easily detected crystalline, scarcely altered rock referred to above, there is in almost every part of the field a great abundance of a dark, greenish, fine-grained rock, exhibiting every sign of extreme metamorphism. This was mistaken by me in the field for an altered sedimentary, but sections of the rock from the vicinity of the

Great Australia and the Argylla, lent me by Mr. Hartwell Conder, of Melbourne, prove conclusively that they are diorite and amphibolites. As they are highly altered, exhibiting all stages down to a hornblende schist, their intrusion must have occurred prior to the metamorphism of the country, but the crystalline rocks first referred to may be of later date.

Southwards on Duck Creek and the Malbon there is little evidence of late igneous intrusion, the diorites there being older than the metamorphism, crushing, and mineralisation (chiefly silicification) of the country.

In considering the genesis of the copper ores, the most likely suggestion is that the copper has been derived from these igneous rocks subsequently to their metamorphism, and has been concentrated along the crush-shear, and fissure-zones where conditions were favourable for depositions.

Besides the diorite, aplite and pegmatite were found in many parts—at the head of Duck Creek, at Mount Hope, at Table Mountain, at Quamby, on the Dugald River, and north-west of Donaldson. These are of much interest as bearing out the statement that certain quartz veins pass gradually into pegmatite. My time was not sufficient to allow of the tracing out of the change in any particular case, but on the various parts of the field were noticed practically all gradations between a normal pegmatite and a quartz vein with a few scattered crystals of orthoclase, while, of course, "blows" of pure quartz are very common. The lenticular nature of the veins in this district would probably prevent any very much more definite assertion than the above, even had much time been spent on the study.

Sandstone, Shales, and Limestones.

Light-coloured sandstones and porcellanous shales form cappings on some of the mesas such as Soldier's Cap and Table Mountain; and a mottled, ferruginous, only partly indurated rock forms flat-topped ridges and outliers along the Selwyn Range—the divide between the Burke and Cloncurry Rivers. These are of Upper Cretaceous age. Mount Elliott lies in a shallow valley incised in the last-mentioned plateau.

Thin bedded, impure limestones and shales of lower Cretaceous age form rolling downs (from which they take their name) extending great distances north, north-east, and east of Cloncurry, and they also extend southwards from Devoncourt homestead (on Spring Creek), beneath the Selwyn Range, down the Burke and Mort Rivers.

Not a single occurrence of copper ores in these rocks has yet been found, and the ore deposits may, therefore, with safety be considered as older than Cretaceous.

Petrology.

The slices, briefly described below, were lent me by Mr. Hartwell Conder, of Melbourne. They clearly indicate that many of the dark-coloured rocks seen are of igneous origin, though it would undoubtedly require much time and labour to delineate the line separating them from the old sediments. The schists also are in many cases amphibolites, probably produced under shearing stresses by the rearrangement of the minerals constituting original diorites.

4. Quartzite, Mt. Norma. A very fine-grained mosaic—chiefly quartz, with only occasional rounded grains of trichlinic felspar and flakes of a brown chloritic mineral. The quartz grains are irregularly shaped and ill defined, and generally, if not always, free from inclusions. Some small grains of zircon were noticed. The rock is apparently of secondary origin.

6. Quartzose rock, Argylla ("Quartz Porphyry"). Felspathic base with slightly schistose structure—pheno-crysts of quartz and felspar—and small fragments of same thoroughout the base, which consists of about equal proportions of granular secondary quartz and feathery laths of kaolinite or cordierite.

7. Granite, Argylla Road. Orthoclase, plagioclase, quartz and biotite. Typical intrusive, granular, crystalline rock.

1. Mica Schist, Mt. Norma. Granular quartz with flakes of biotite. A few needles of sillimanite (?).

8. "Hornstone" (Chalcedonic vein quartz), Great Australia. Chalcedony-spherulitic and stained yellow. Quartz in kidney-shaped, bell-shaped, and generally rounded spots. Also dark-brown opaque areas of limonite.

A secondary rock accompanying most of the ore deposits, and variously referred to in this report as silicified limonite, ferruginous chalcedony and yellow jasperoid.

2. Amphibolite. Aligned acicular hornblende, some prismatic sections showing cleavage, in a base consisting chiefly of secondary silica, though there are patches that may have been felspar. The minerals are of secondary origin.

5. Diorite, Argylla. Microcrystalline hornblende, some twinned kaolinised felspar, magnetite in skeleton forms, and a very little free quartz.

11. Quartzite, Cloncurry. Granular quartz and plagioclase, cemented by secondary silica, the felspar being more especially in nests.

12. Schist, Great Australia. Flakes of chlorite and also of hornblende (some showing prism cleavage), with magnetite and kaolinite (?) base.

10. Schist, Great Australia. Crushed hornblende, kaolinised felspar, coarse-grains quartz, and magnetite in altered hornblende.

Register of Minerals,

With composition and associations noted in the description of the mines (Part 2).

Actinolite (Magnesium-calcium iron silicate).—Monoclinic, greenish needles.

Daisy United: Associated with calcite and epidote in metamorphosed eruptive (?). Melba: In siliceous formation. Wanderer: In metamorphosed sediments.

Ankerite (Calcium-magnesium-iron carbonate).—Rhombohedral. Buff.

Mount Bornite: Lenticular beds.

Atacamite (Copper oxy-chloride).—Copper = 63%. Rhombic. Emerald green.

Mounts Elliott, Wheeler, and Weka: Minute crystals in gossan. Mount Oxide: In crystalline form with malachite.

Azurite (Hydrous copper carbonate).—Copper = 55·5%. Monoclinic. Blue.

Balfour, Boomerang, Caine's King, Cleopatra, Easter Gift, Eringo-bragh, Eva, Ma Foi, Magnet, Mavis, Monitor, Pioneer, Pumpkin Gully, and Thistle: As stains. Mighty Atom, Morning Star, and Wallaroo: Impregnations. Celestial and Federal: In crystalline form.

Biotite (Magnesium-potassium-iron-aluminium silicate).—Monoclinic. Black.

Mavis: Flakes with chlorite, felspar, quartz, and ilmenite.

Bismutite (Bismuth carbonate).—Greenish.

McEvoy's: Lumps with chalcopyrite, malachite, quartz, and tourmaline.

Bismuth (native and carbonate) occurs with gold at Top Camp,* and the Warden, in March, 1901, reported it to occur in flakes and patches through copper formation in Willmett's claim, Duck Creek, from which 2 cwt. was shipped.

Black Oxide (Cupric oxide).—*See* Melaconite and Tenorite.

Hampden and Mount Cuthbert; probably really sulphide.

Bornite (Copper-iron sulphide).—Copper 50-70%. Cubic. Brown. Metallic.

Mavis, M.F. 19, Pumpkin Gully, and Timberoo: Probably enriched chalcopyrite. White Rose: Irregular bunches and veins in quartz and calcite.

Calcite (Calcium carbonate).—Rhombohedral. Colourless. Vitreous.

Daisy United, Eva, Hare's Excelsior, Hilda, Ida, Mascotte, Mount Elliott, Pioneer Chief, and Queenslander: In formation. Block 25, Blue Jacket, Duchess, Shamrock, and Yeronga: Veins. Belfast, Dandy, Enfield, Glenferrie, Great Australia, Mavis, Mount Wheeler, and Pilgrim: In beds. Brilliant, Marguerite, and Mount Wheeler: Intercrystallised with quartz.

Chalcedony (Silica).—Crypto-crystalline. Glassy.

Ardath: In chalcopyrite. Dreadnought: Replacing limestone. Easter Gift: Brown chert. Jessie and Mount Elliott: In limonite. Mount Hope North: In schist. Pioneer Chief: Cementing quartz. Wee MacGregor Extended: Vein.

Chalcocite (Cuprous sulphide).—Copper = 80%. Massive. Metallic.

Chalcocite occurs in massive and in crystalline form at most of the mines on the field, besides which it occurs as strings in chalcopyrite, as disseminations in limonite and malachite, and as a dull powder ("black oxide"). Most abundant at the Duchess.

Chalcopyrite (Copper-iron sulphide).—Copper = 34%. Tetragonal. Yellow, metallic.

Chalcopyrite occurs as specks in the gossan and chalcocite at the majority of the mines, but veins of the mineral were seen at the Pioneer and Lady Fanny.

Chert (Impure silica).—Amorphous, subvitreous.

Easter Gift, &c.: Cementing quartz.

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* G.S.Q. Publication No. 104. By William H. Rands.

Chlorite (Hydrous magnesium-aluminium-iron silicate).—Monoclinic. Dark-green.

Caine's King and Cleopatra: Lines and flakes in quartz. Eva Extended: In quartzite. Hampden Block 25: Flakes in calcite. Highland Mary: Lenses in altered eruptive. Mavis: In felspar rock. Mount Wheeler: Crystals in calcite and pyrite.

Chrysocolla (Hydrous copper silicate).—Copper = 36%. Amorphous. Blue or green.

Chrysocolla is almost as abundant as malachite, but the best specimens were obtained from the Highland Mary and Springs Peaks, though it is very abundant at Mount Wheeler.

Covellite (Cupric sulphide).—Copper = 66%. Blue-black.

Ardath: In small quantities; doubtful.

Cuprite (Cuprous oxide).—Copper = 89%. Cubic. Red, glassy, or earthy.

Cuprite is found in most parts of the field; at Mount Elliott in minute veinlets in the gossan, but elsewhere, particularly at the Hampden and Great Australia, as nodules, often enclosing a nucleus of copper.

Cyanochalcite (Hydrous copper silicate).—Copper = 36%.

Dandy: With malachite, chalcocite, cuprite, and chalcedonic silica.

Dioptase (Hydrous copper silicate).—Copper = 40%. Hexagonal. Emerald-green.

Banjo and Weka: Doubtful, with chrysocolla. Belfast: Doubtful, with calcite. Mount Elliott: Stains. Mount Wheeler: With chrysocolla, atacamite, and malachite in limonite. Trump: With glance, malachite, chrysocolla, and pyrite.

Dolomite (Calcium-magnesium carbonate).—Rhombohedral. White.

Mount Wheeler: Reported by Mr. Waller. Atlanta: In crush-zone.

Enriched Chalcopyrite.—This is chalcopyrite from which some of the iron sulphide has been removed, so that the mineral now appears to be veined with chalcocite. The process has sometimes been carried on so far that only specks of the chalcopyrite can be distinguished in massive chalcocite, but more often it forms a mosaic referred to below as tesselated ore. Enriched chalcopyrite occurs at most of the mines, but especially good examples were seen at the Pioneer Chief.

Epidote (Hydrous aluminium-calcium-iron silicate).—Monoclinic. Yellow to green.

Daisy United: Needles with actinolite and calcite in diorite (?). Highland Mary: Amygdules coated by chalcedony in eruptive (?). Hilda: In eruptive (?). Springs Peaks: Granules with felspar, hypersthene, quartz, and hæmatite.

Epsomite (Hydrous magnesium sulphate).—Fibrous. White.

Duchess: Efflorescent on roof of old drive.

Erubescite (*See* Bornite).

Centipede: Splashes with chalcopyrite in limestone.

Felspar (Alumium-sodium-potassium-magnesium-calcium silicate).—Monoclinic. Grey.

Springs Peaks: Crystallised in association with hypersthene, quartz, epidote, and hæmatite.

Ferro-calcite (Calcium-iron carbonate).—Rhombohedral. Brownish.

Dandy: With cuprite and limonite. Glenferrie: With chalcopyrite, glance, and limonite. Gorge Hotel: With quartz and ilmenite. Ida: With chalcopyrite. Marguerite: With quartz and pierced by tourmaline. Policeman: With hæmatite and chrysocolla.

Glance (Cuprous sulphide).—*See* Chalcocite.

Gold.—Alice and Daisy United: In quartz. Mighty Atom: Residual in gullies. Flying Dutchman: Reported. Hampden: In copper ore. Lady Fanny, McPhail, and Mount Elliott: In gossan. Last Call: Reported. Unnamed north of Lady Fanny: As paint on hæmatite.

Gothite (Hydrous ferric oxide).—Earthy. Yellow.
Brilliant: In gossan. Mountain Maid: Earthy. Mount Wheeler: Pseudomorph after pyrite.

Grey Copper Ore (copper sulph-antimonide).—Copper = 38.6%. Cubic, Grey, metallic.
Rainbow: Reported by Dr. Jack.

Grey Ore (Copper sulph-antimonide).—Copper = 38·6%.
Argylla and Pumpkin Gully: Reported by Mr. Jack.

Gypsum (Hydrous calcium sulphate).—Monoclinic. Colourless, vitreous.
Mount Wheeler: With calcite and pyrite.

Hæmatitè (Ferric oxide).—Rhombohedral. Red to black, metallic.
Belfast: Rosettes and sheets on cleavages planes of calcite. Crusader: With magnetite and malachite in sericite. Dandy: With copper ore in limestone. Easter Gift: Granular. Great Australia: Pisa Hill and small crops north of the main workings. Gorge: Flaky. Jessie and Mount McCabe: Reported. Mount Sylvia: Granular. M.F. 3: Crops. Policeman: With ferro-calcite. Springs Peaks: Grains with felspar, hypersthene, and epidote. Thistle: Schistose, micaceous, and granular crop. Timberoo: Massive. Un-named north of Lady Fanny: Crystalline.

Hornblende (Iron-magnesium-aluminium-calcium-manganese silicate).—Monoclinic. Greenish.
Lady Fanny: With chalcopyrite in schist.

Hyalite (Silica).—Amorphous, mammilated. Colourless.
Mount Wheeler: Thin films coating chrysocolla and cavities in limonite.

Hydromica (Hydrous aluminium-magnesium silicate).
Timberoo and Mount Minde: Crystalline aggregates in gossan.

Hypersthene (Magnesium-iron silicate).—Rhombic. Greenish-brown, pearly.
Springs Peaks: With felspar, quartz, epidote, and hæmatite.

Ilmenite (Iron titanate).—Rhombohedral. Black, submetallic.
Gorge Hotel: With ferro-calcite and quartz. Mavis: Orthoclase, quartz, and biotite.

Jasper (Silica stained by ferric oxide).—Amorphous. Reddish.
Deadlock: Cementing quartz crystals. Dreadnought: Very ferruginous and slightly cupriferous, probably replacing limestone. Excelsior: Cherty, in limestone. Good Luck: Reported by Mr. Rutherford. Mighty Atom: Yellow, replacing limestone. Mount Cuthbert No. 1 North: Yellow, banded. Queenslander: Yellow, with copper ore and calcite in formation. Thistle: Yellow, replacing limestone.

Jasperoid (Possibly silicified country rock).—Red or yellow.
Mount Elliott: At surface and at 125-ft. level passing into limonite. Trump: Crush-zone (?). Yeronga: Cementing quartz.

Limonite (Hydrous ferric oxide).—Non-crystalline. Brownish.
Limonite occurs in practically every cupriferous crop, and is very prevalent throughout whole strata. The Mount Elliott crop is the largest seen.

Liver-coloured Ore.—This is a fine-grained and intimate mixture of chalcopyrite, tile-ore, limonite, and chalcocite, with impregnations of malachite. It is found at most of the mines, the Eclipse being a good example.

Magnesite (Magnesium carbonate).—Rhombohedral, usually massive. White.
Mount Cuthbert No. 2 South: Sinter in kaolinised schist.

Magnetite (Ferroso-ferric oxide).—Rhombohedral. Reddish when earthy.
Crusader: Granular, with hæmatite and limonite (after pyrite), and also associated with malachite. Gorge Hotel: Crystals in country rock. Patchwork: With quartz and copper ore.

Malachite (Hydrous copper carbonate).—Copper = 57·5%. Monoclinic. Fibrous, green.

Alice: Radiating 3-in. spheres encrusted by chalcedony or chrysocolla. Banjo: Replaced by chrysocolla. Chum: Acicular, with crystalline cuprite, chalcocite, or limonite. Crusader: Radiating spheres in plumose sericite. Cummin's: Radiating spheres coated with secondary silica. Lady Clayre: Radiating spheres. Tambourine: Radiating nodules with chalcedony on joints.

Manganese dioxide.—Fibrous. Black.

Hilda: gossan. Mount Cuthbert No. 1 North: Stains in quartz breccia (cemented by limonite). Slaty Creek (1 mile south of Gorge Hotel: In slate.

Melaconite (Cupric oxide).—Copper = 80%. Powder. Black.

Mount Metallic: In cellular limonite with malachite.

Molybdenite (Molybdenum sulphide).—Foliated. Grey, metallic.

May Graham: In chalcopyrite-chalcocite ore.

Native Copper.—Octahedral. Reddish.

Banjo: In tile-ore. Blue Jacket: With malachite, cuprite, and chalcocite in limonite. Boundary: In cuprite. Crusader: With glance. Dandy: With cuprite in calcite. Great Australia: With cuprite in formation. Jessie's Dream, May Graham, M.F. 14, Mount Cuthbert, and Oliver Twist: With cuprite. Little Wonder: Surrounded by concentric cuprite. Mount Metallic: Crystalline in cuprite.

Oxychloride.—See Atacamite.

Mount Oxide: Bunch in schist.

Porcellanite.

Highland Mary: With chrysocolla and malachite.

Pyrite (Iron sulphide).—Cubic. Silvery, metallic.

Pyrite was noted in a great number of localities, the largest block seen being at the Hampden. Much of it is thought to be leached chalcopyrite.

Quartz (Silica).—Hexagonal. Colourless, glassy.

Quartz has been concentrated in various forms and in great quantities in every part of the field. The quartz "blows," rising like ruined walls, mark lines of crush-zones. In these the quartz which at least in part replaces schist, is generally granular, but the crystals were sometimes seen, and "dog-tooth" structure is not uncommon. Quartz has also indurated porous strata of some thickness over great distances.

Red Oxide.—See Cuprite.

Argylla: Reported by Mr. Jack. Mount Leslie: Reported by Mr. Rutherford.

Ruby Ore.—See Cuprite.

Pooncairie: Reported.

Scheelite (Calcium tungstate).—Tetragonal. Yellowish.

Shamrock: Reported. Slaty Creek: The Warden, in October, 1901, reported that scheelite had been found in small quantity on Slaty Creek. West Hampden: Scheelite has been twice reported from West Hampden. Colton and Woodhouse, in May, 1905, reported that the following assays of ore from their claims had been made by the Irvinebank Mining Company:—

No. 1 Scheelite.		No. 2 Scheelite and Wolfram.	
Cu	= 1·68 per cent.	Cu	= 2·60 per cent.
FeO	= 3·88 ,,	FeO	= 9·02 ,,
WO_3	= 70·30 ,,	WO_3	= 70·30 ,,
CaO	= 15·70 ,,	CaO	= 12·00 ,,
	91·56 per cent.		93 92 per cent.

Woodhouse and Tait, in May, 1906, shipped 5 cwt. of scheelite, assaying 75% tungstic acid.

Schorl.—See Tourmaline.

Shamrock: With quartz, calcite, and chalcopyrite. Tambourine: Needles in quartz.

Secondary Silica.

Cummins': Coating malachite. Great Australia: Ferruginous. Mount Cuthbert No. 1 North: Cavities in limonite Mount Wheeler: Coats on limonite. Pooncairie: Reported. Tambourine: With chrysocolla. Yamamilla: Reported to cement quartz.

Secondary Sulphide.—Probably earthy chalcocite, often mistaken for Black Oxide.

Isabella No. 4 North: With chalcopyrite. Italian: In softened schist. Mount Cuthbert: Leaders. Mount Elliott: In gossan and kaolinised slate on 125-ft. level. Pearl: Coating glance. Ruth: In cellular gossan. Springs Peaks: Films in chalcopyrite. Una: With malachite.

Selenite (Hydrous calcium sulphate).—Monoclinic. Colourless.

Mount Wheeler: With quartz, calcite, and pyrite.

Sericite (Aluminium-hydrogen-potassium silicate).—Scaly muscovite.

Crusader: Plates and plumose aggregates in schist. Further, most of the crushed rocks of Cloncurry may at least provisionally be classed as sericite schists.

Serpentine (Hydrous magnesium silicate).—Amorphous. Greenish.

Springs Peaks: Alteration product of hypersthene.

Siderite (Iron carbonate).—Hexagonal. Buff coloured.

Noontide: With chalcocite and malachite in formation, altering into turgite. Pumpkin Gully: With quartz.

Silicified limonite.—See Jasperoid and Chalcedony, of which this appears to be a ferruginous form.

Argylla: Passing into quartzite. Brilliant, Noontide, Pioneer Chief, and Policeman: In crush-zones Dandy, Dreadnought, Fairfield, Ivanhoe, and Trump: Replacing limestone. Great Australia: Crush-zones.

Sinter (Calcium-magnesium carbonate).—Amorphous.

Advance: Produced from weathering of hornblende rock. Atlanta: In formation Blue Bell: In ore. Daisy United: In ore and country. Excelsior: Earthy white with jasper in limestone. Hare's Excelsior: In formation. Little Wonder No. 1 North: Floors in ore. Queen Bee: Floors in formation. Resurgam: Floors in ore. Yeronga: Earthy with ore.

Specularite.—See Hæmatite.

Gorge Hotel: With limonite and copper ore. Crusader: Mr. Jack reported in talc. M.F. 19: Manager reported with bornite and chalcopyrite.

Talc (Hydrous magnesium sulphate).—Rhombic. Foliated. White.

Crusader: Reported by Mr. Jack.

Tenorite (Cupric oxide).—Copper = 80%. Earthy. Black.

Hampden: Reported in pyritic ore.

Tile-ore.—Tile-ore is impure, earthy, ferruginous cuprite, of varying composition. Tile-ore is to be seen in almost every crop.

Blue Bell: With chalcocite. Labour Victory: Containing malachite. Malbon Freehold: With malachite.

Tourmaline (Hydrous lithium (or sodium)-iron (or magnesium)-boron-aluminium silicate.—Hexagonal. Black (*see* Schorl) or variously coloured.

Marguerite: Needles in quartz and ferro-calcite. McEvoy's: Needles in quartz, associated with bismutite and copper ore. Native Companion: In decomposed, calcareous rock. Shamrock: Needles in quartz, reported with scheelite. Tambourine: In quartz. Weka: Radiating needles in altered sedimentary rock. Tourmaline also occurs in quartz and calcite, with chalybite at the Uncle Tom reef, Pumpkin Gully,* and and the Cloncurry road, a few miles east of Quamby, in pegmatite dykes.

* G.S.Q. Publication No. 104. By William H. Rands.

Turgite (Hydrous ferric oxide).—Reddish.

Highland Mary and Noontide: Earthy, in ore. Mount Wheeler: Earthy. Trump: With jasperoid on crush-zone.

Tessclated ore. See Enriched Chalcopyrite.—Chalcopyrite, altering into chalcocite and limonite.

Ardath, Easter Gift, Highland Mary, Hilda, Little Beauty: With malachite. Mascotte: Chiefly limonite. White Rose.

Wolfram (Iron manganese tungstate).—Wolfram has been reported from West Hampden, where it occurs with scheelite. (*See* Scheelite.)

COPPER ORE DEPOSITS.

Nature and Genesis.

It has been remarked by Mr. Cameron that "The copper outcrops and deposits run almost universally with the strike of the country rock, and are distinctly bedded deposits and not fissure lodes,"* but subsequent investigations show the deposits to be on fissure-, shear-, or crush-zones.

With the following statement of Mr. Cameron's I am quite in accord:—

> This leaching out and concentration of the copper above water-line accounts for the presence of the phenomenally rich ores that are found outcropping at the surface all over the Cloncurry District. . . . Below the water-line they will no doubt be replaced by the ordinary low-grade sulphide ore, which has been met with in one shaft in the Hampden mine. . . . . The various surface deposits are generally too irregular, both in quality from point to point and in extent, to allow of more than rough guesses at their value being made.

Full descriptions are given in Part II. of this report of most of the exposures accessible at the beginning of the year 1907, but no attempt has been made to estimate quantities of ore available on the various lines between disconnected workings, for the reasons already given.

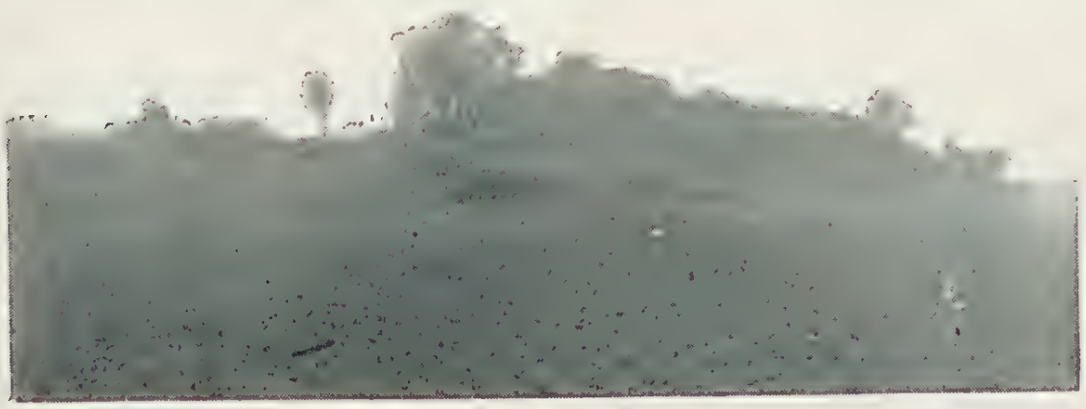

FIG. 5.—MAIN CROP, GREAT AUSTRALIA, LOOKING SOUTH.

Mr. Rutherford, in his "Conclusion," states that the ore (on the Cloncurry field) occurs in two ways:—

> (1) As an impregnation (usually in the form of green carbonate) of the metamorphosed sandstone which occurs almost all over the field forming the hills and ranges.

* Op. cit. (Rec. developments in the Clon. Copper Mining District).

(2) As small lenticular deposits of rich ore deposited in foldings or along bedding planes of schists and shales. These usually occur in flat country where the overlying sandstone has been almost entirely removed by denudation.

In the case of the first mode of occurrence what are known as "reefs," "dykes," and "outcrops" in the district are simply beds of quartzite interbedded with the sandstone from which they were formed.

It has already been shown that the copper is more likely to have been derived from basic igneous rocks than from white quartzites, and it has also been pointed out that the quartz "blows" or "reefs" are interlaminated with the schists, and do not unconformably overlie these rocks.

While at work in the field it was thought that the Cloncurry iron ores were of pneumato-hydatogenetic origin—*i.e.*, had been given off in residual gases from cooling acidic magmas, but a study of the recent literature of the subject has convinced me that both iron and copper ores are due primarily to regional metamorphism, perhaps enriched in parts by ascending metalliferous solutions.

Regional Metamorphism.

It has been pointed out by Lindgren* that—

There are certain deposits which owe their origin to dynamo-metamorphic or regional metamorphic processes. . . . . Characteristic for the regional metamorphic deposits are (1) the association of oxides of iron with sulphides so utterly foreign to the deposits formed by ascending waters, and (2) the minerals (garnet, amphibole, epidote, &c.), which distinguish the contact deposits. Bornite, so common in the latter, does not, however, seem to occur in regional metamorphic deposits. In regional metamorphism there has been but little transportation of substance; the masses of ore are rather old disseminations or originally sedimentary deposits concentrated and rearranged under the influence of heat and permeating moisture.

The Cloncurry district meets the above in every particular, even in the absence of bornite. Amphibolite schists are met in all parts; epidote is found in certain altered rock; and garnets were noted on Cattle Creek, in the Corella catchment area.

The above-named author, in his paper on "The relation of ore deposition to physical conditions,"† refers to two methods of formation—

(*a*) By static hydro-metamorphism. It is a well-known fact that basic rocks like diabase . . . . . almost invariably contain an easily-determinable percentage of copper. . . . . The ordinary forces of hydro-metamorphism are sometimes sufficient to concentrate these minute quantities into workable copper deposits. Hæmatite is a characteristic mineral.

(*b*) Under conditions of stress. Many copper bearing rocks of the character just described have been transformed by the action of stress and metamorphism into chloritic or amphibotitic schists with local masses of pyritic copper ores. Under these conditions pyrite, chalcopyrite, pyrrhotite, and magnetite are stable, as are quartz muscovite, biotite, epidote, hornblende, and albite, a combination which, in the formation of deposits by thermal waters, is only duplicated in contact metamorphism or in the abyssmal veins.

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* "Character and Genesis of Certain Contact Deposits." By Waldemar Lindgren. Trans. Am. I.M.E. 1901.

† Ore Deposition and Physical Conditions. By Waldemar Lindgren. Interl. Geol. Congress, in Mexico, 1906.

Magnetite is found as well as chalcopyrite in ore deposits formed under conditions of stress.

The Cloncurry deposits may possibly be due, at least in part, to the metamorphism of originally cupriferous igneous rocks, as described under the second paragraph. The cupriferous schists of Hampden (and the Lady Fanny) may well have had such an origin, undoubted igneous rocks occurring at both places.

Secondary Enrichment.

In arriving at the genesis of the richer deposits, it must be remembered that they almost all occur in the flat bottoms of the valleys, the chief exceptions being on the Corella River and Argylla Creek, and at Mount Oxide. There is evidence in the equi-altitudinal ranges and mountains, rising several hunderd feet above the valley bottoms, of a peneplain having existed, prior to the dissection of which mineralisation by *rising* solutions took place, chalcopyrite being precipitated in crush-zones on the schist generally in small quantities. The dissection and degradation of the old peneplain are so far advanced—it being now represented by narrow table-topped ridges and chains of conical hills, palpably the stumps of ranges, themselves the harder ribs of the peneplain—that there are already indications of a future Duck Creek—Chinaman Creek peneplain. The amount of material removed during the erosion of the valleys has been enormous—to be calculated in units of cubic miles—and has gone to build up the Cretaceous strata to the east.

During denudation some of the copper ore would be carried off mechanically by the surface streams, but the greater part of the ore, owing to its relatively high specific gravity, would tend to sink beneath the soil and subsoil, where it would come within the sphere of action of meteoric waters, acid laden from the oxidation of the primary sulphides. When fissure- or crush-zones offered a ready passage the course of these waters would be a descending one, and the copper would be precipitated by the first pyritic ore encountered.

The general occurrence of rich secondary ores at the surface is due to the valley bottoms, which are near the present base level, being near the water level of the old peneplain. The present water level is 20 to 70 ft. below Duck Creek, and the rich ores have not yet had time to migrate downwards. The proportion of original pyrite is low, as proved by the general absence of gossan, and the amount of acid produced by its oxidation is insufficient to make any perceptible effect on the ore bodies. Any copper that does go into solution is almost at once precipitated, changing cupriferous pyrite to chalcopyrite, and chalcopyrite to chalcocite, iron at the same time going into solution.

Most of the quartz is probably of the same age as the cupriferous pyrite, but chalcedonic jasper (often referred to as silicified limonite) is in all cases younger.

The general absence of considerable massive glance in ore-bodies at any elevation above the valleys seems to indicate that secondary enrichment does not there become complete, owing to the rapid downward course of the cupriferous waters.

While the primary circulations causing solution of the copper may in some cases be ascribed to pneumatolytic after-action of a cooling batholith, continued activity of the ore solutions may have been connected with the production of huge monoliths and razor-backs, such as that to the west of the Mount Hope leases (1,000 ft. high, 2 miles wide, and several long). The development of peneplains and wide valleys having left these masses without lateral support, their whole weight thus bears on limited areas of underlying, perhaps relatively shallow, magmas. It is conceivable that under these circumstances rising solutions would be more likely to rise towards the newly formed valleys, the areas of low pressure. Precipitation would follow on reduction of pressure and temperature. This theory is applicable to most of the Cloncurry groups, the mines being generally in the broad valleys.

The wide-spread occurrence of chalcedony in the oxidised ores—*e.g.*, McPhail, Mount Elliott, Mount Walker, &c.—as one of the latest minerals deposited, may be taken as evidence of a deep-seated action, for silica does not readily go into solution at the earth's surface, but is to be easily dissolved at great depths. Silica is precipitated again under considerable pressures as quartz, but near the surface as chalcedony, and the occurrence of which in the gossan is evidence of continuity of action of the uprising solutions.

The finding of nodules of cuprite and native copper near the surface was one of the features of the early days at Cloncurry, and naturally these were the first ores shipped. No good specimens were seen by me in Cloncurry, but numbers have lately been unearthed in the vicinity of the Great Australia crops. Mr. Condor, of Alex Hill and Stewart, when passing through Brisbane, showed me some of the specimens, and expressed the opinion that they had been formed *in situ* by precipitation in the alluvium. It has generally been accepted that the nuggets are shoads—that is to say, have been shed during the denudation of overlying country, in which they occurred as scattered bunches near lodes. Against this assumption is the fact that most of the masses found in the schists are very irregular in form, while those shown me by Mr. Condor have a smooth surface, slightly pitted, and, further, some indication of concentric structure. Copper has been abundantly proved to generally leach downwards in almost if not all lodes, but there is no reason why upward seepage should not take place in cupriferous country such as schist.

The recent discovery of large nuggets of native copper in the placers along Copper River, Alaska,* is to be noted in this connection,

* "Engineering and Mining Journal." 6/4/07, p. 674.

but few particulars are available as to the nature of the nuggets and their source is believed to be beneath the glaciers at the head of the river.

Chemistry of Deposition.

A brief reference to the chemistry of ore deposition is advisable in order to bring out the probable genesis of the deposits.

Secondary chalcopyrite may be produced in two ways—*first*, by oxidation and leaching of excess iron sulphide from lean pyritic ores—

$$FeS_2 + (CuFeS_2) + 3O_2 = CuFeS_2 + FeSO_4 + SO_2.$$

Second, by the action of soluble copper salts on pyrite—

$$2FeS_2 + CuSO_4 + O_4 = CuFeS_2 + FeSO_4 + 2SO_2.$$

Enrichment takes place as follows:—(1) Primary chalcopyrite or cupriferous pyrite, in the oxidising zone, breaks up and oxidation proceeds along the cracks formed. Limonite always appears as one of the products, and chalcocite is generally present also, in varying amounts.

The oxidation of chalcopyrite* is expressed as follows:—

$$CuFeS_2 + 8O = CuSO_4 + FeSO_4.$$

Then,

$$FeSO_4 + O = Fe_2(SO_4)_3$$

and

$$Fe_2(SO_4)_3 + H_2O = \text{basic sulphates} + Fe_2(HO)_3 + H_2SO_4.$$

The production of glance may then take place from the action of the copper sulphate either on pyrite or chalcopyrite:

$$14CuSO_4 + 5FeS_2 + 12H_2O = 7Cu_2S + FeSO_4 + 9H_2SO_4 + 3H_2SO_4.$$

The removal of copper from the zone of weathering depends on the action of ferric sulphate on sulphides:

$$Cu_2 + Fe_2(SO_4)_3 + 2O_2 = 2CuSO_4 + 3FeSO_4.$$

This reaction can seldom occur in the Cloncurry district, because of the breaking up of the ferric sulphate with the production of limonite.

Replacement of the limonite by chalcocite appears generally to have taken place, and sometimes only traces of the former can be detected, though small specks of the original chalcopyrite are abundantly scattered through the chalcocite. The generally adopted equations are as above.

Amorphous sulphide is produced by the action, on chalcopyrite, of ferric sulphate, which removes iron:

$$Cu_2S\,Fe_2S_3 + Fe_2(SO_4)_3 + 6O_2 = Cu_2S + 2Fe_2(SO_4)_3.$$

The production of cuprite in the Cloncurry district would seem to occur under special conditions, chief of which is the presence of lime-

* Prof. paper. 43. U.S. Geol. Sur., p. 183.

stone. The cuprite always occurs in irregular form, surrounded by limonite, which it appears to replace, and in certain cases contains a kernel of native copper. This is the latest product, and has been reduced from the cuprite by its action on solutions produced during the oxidation of chalcopyrite:

$$Cu_2O + H_2SO_4 = Cu + CuSO_4 + H_2O.$$

$$Cu_2S + 3Fe_2(SO_4)_3 + 4H_2O = 2Cu + 6FeSO_4 + 4H_2SO_4.$$

The precipitation of native copper or covellite by the action of copper sulphate on pyrite in the absence of air—*i.e.*, in upper part of ground—the water is shown thus:

$$CuSO_4 + FeS_2 = CuS + FeSO_4.$$

Production of native copper results when copper sulphate acts on chalcopyrite:

$$CuSO_4 + CuFeS_2 = 2Cu + FeSO_4 + S_2.$$

Occurrences Beyond Queensland.

New South Wales.

The Girilambone* lodes are to be compared with certain Cloncurry deposits.

There are two copper-bearing lodes.

The outcrops do not show any genuine gossan, but are ironstained contorted slates, which do not show any copper minerals on the surface, except in one or two places, where the lode material is kaolinised. The main lode does not appear to have any distinct walls.

It strikes approximately east and west, and is cut across by an east and west slide, which throws the lode down to the east. The south lode underlies towards the main, and is expected to junction with it.

Tasmania.

The Mount Lyell ore deposits are of two types—mineralised bands of schist (fahlbands); and great lens-shaped masses of very fine sulphide ores—the latter supplying the greater part of the output. The Mount Lyell main body is 10 ch. long and 4 wide at the No. 4 level, and is believed to be cut off at 97 ft. below No. 8 level.

The average composition of the pay ore, which is remarkably uniform,† is:

Fe	40·30	Cu	2·35
SiO_2	4·42	Al_2O_3	2·04
$BeSO_4$	2·50	S	46·50

It is estimated that its original mass was 4,187,499 tons.

The ore bodies are in schist, near a big fault (where crossed by secondary faults) separating them from conglomerates, and were formed by replacement of the pre-existing rocks, the pyrite being introduced in solutions.

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* *Australian Mining Standard*. 10 4 07, p. 345. "Girilambone Copper Mine, Cobar District. F. Danvers Power, A.I.M.E., etc.

† The percentage of copper decreases with depth.

Western Australia.

The Cloncurry schist has much in common with that covering the greater part of Western Australia.

Coarse crystalline schists and gneiss, which differ but little from granite and other rocks of like origin, as well as basic rocks, which have been more or less crushed, foliated and completely converted into greenstone schists. . . . . Some of these older rocks are of sedimentary origin, and are practically unaltered; others are quartz, mica-schist, and granulites.*

*Recent advances in the knowledge of the Geology of Western Australia. By A. Gibb Maitland, F.G.S., Govt. Geologist. G.S.W.A. Bull. No. 26, p. 37.

The laminated quartzites and jaspers, so characteristic of the schist areas of Western Australia, have been proved to "pass by almost insensible gradations into the enclosing basic schists, the whole appearance suggesting a gradual replacement of the original rock along lines of maximum compression." They would, therefore, appear to be genetically related to the siliceous crush-zone formations of Cloncurry, which, however, are associated with copper deposits, where the Western Australia are associated with gold-bearing reefs—*i.e.*, in the more basic schists.

The quartz blows of Cloncurry seem to have their exact counterpart in the Pilbarra "quartz reefs, which stand up to considerable altitudes above the surface like a wall, and which can in some cases be traced across country, with more or less interruption, for miles."* These, it has been suggested, may be genetically connected with pegmatites, as seems probable, in certain cases at least, in North Queensland.

Wyoming.

A description of copper deposits of the Hartville Uplift, Wyoming, has just been published by Mr. Sydney H. Ball.†

Certain of these deposits and those in the Cloncurry districts have much in common, lenticular or globular masses pinching out at slight depths in Pre-Cambrian schists and limestones, and doubtful fissure veins have been indicated. It is held that the more important deposits were deposited by descending waters, seeping from overlying sedimentary deposits. The ores found are the same as those at Cloncurry, with the addition of bornite, and the association of hæmatite and impure flint (heavily iron-stained jasper) in the schists is another point of resemblance. The iron ore in many cases is considered to have been an important precipitant of copper, but it is stated that the copper ores are in no way connected with the igneous rocks.

* Op. cit. Rec. Adv. Geol. of W.A.

† Contributions to Economic Geology, 1906, U.S. Geological Survey. Bulletin No. 315, p. 93.

California.

Bully Hill district:

The ore bodies occur very irregularly distributed in shear-zones, and range in size from lenticular or sheet-like nodules less than an inch in diameter to hundreds of feet long, and up to nearly a score of feet in thickness. The crushed rock in the shear-zone is not always mineralised, but generally it is more or less richly impregnated with ores, sometimes to complete replacement.*

Great lenses of pyritic ore occur in a shear-zone traversing meta. rhyolite in Shasta Co., Calif.†

* Copper deposits of the Redding Region, Calif. By J. A. Diller, U.S. Geol. Sur. Bull. No. 213, p. 126.

† Copper production of the United States. By Walter Harvey Weed. U.S. Geol. Sur. Bull. No. 260, p. 216.

Vermont.

In the Vermont copper belt the deposits occur along a due north-south line, which corresponds to the general direction of schistosity of the rocks—grey micaceous schists and gneisses, formed from sandstones and shales by regional metamorphism.

Intercalated in the schist are masses of quartz, produced during the sericitisation of the original sediments—silica being freed when ordinary silicates change to sericite.

The ore deposits occur as lenticular masses, conforming to the foliated of the schists.

At each locality but one workable lens has been found outcropping, and in the deep mines the lens wedges out in depth, but is found to overlap the upper-tapered end of another lens in the footwall rock.*

*Notes on the Copper Mines of Vermont. By W. H. Weed. U.S. Geol. Sur. Bull. No. 225, p. 190.

The deposits have no gossan cap, the sulphides appearing at the surface.

At the Ely Mine the lenses have been proved to repeat to 1,500 ft. from the surface. The thickness is variable, the Elizabeth ore-body being 100 ft. wide in the opencut.

The ore consists of pyrrhotite, with scattered grains and irregular masses of chalcopyrite, and small amounts of pyrite and of zinc blende; and the gangue minerals consist of quartz, acinolite, garnet, and other metamorphic minerals. The average copper content is 3 per cent., though originally much higher. The mineralogical associations are thus quite dissimilar to those in the Queensland mines.

Tennessee.

The ore-bodies of Ducktown comprise replacement deposits along faults in schists and gneisses. The ore minerals are pyrrhotite and pyrite.

Mexico.

Impregnated shear-zones are found in Sonora, Mexico*—usually without distinct walls. Ore bodies are impregnations of decaying country rock, irregular in form, and not occupying the whole of the zone.

A saturation of sheared or shattered rock in a zone of fracture and displacement, with metal-bearing solutions, without the normal accompaniment of quartz, calcite, or other vein stone.

A second important type is the barren quartz vein with rich impregnations in the enclosing rock.*

* E. and M. Jour. 6/4/07, p. 657. F. I. H. Merrill.

Rammelsberg.

True vein formed in shear-zone along fault, by which the Rammelsberg rock series was inverted "genetically dependent on an acid eruptive rock." (Vogt.) Lentic masses, 40 to 60 ft. thick and up to 4,000 ft. long. Pyrite with copper-pyrite and fablore.

IRON ORE DEPOSITS.

Town.

Mount Leviathan.

Mount Leviathan lies on the western side of the Cloncurry River, a quarter of a mile above its junction with Chinaman Creek. The township of Cloncurry is within 1½ miles to the east-north-east. The highest point of the mountain is about 270 ft. above the adjacent red soil flood-plain.

The summit of the mountain is composed of dense hæmatite, with a little quartz. A chain to the west of the top the quartz veinlets are so frequent that the silica content is at least 10 per cent., and a great part of the mountain contains at least 20 per cent. silica. The southern end of the mountain is a little freer from quartz than the main mass.

Another rather siliceous crop, 1½ chains wide, is to be seen on the bank of the Cloncurry River, within ¼ mile of the Boulia Crossing, and only 15 ch. from the nearest part of the Mount Leviathan crop, with which it may be connected.

The quartzite crop, ¼ mile south of the mountain, is 2½ ch. in length and up to 20 ft. in width. It has a horny texture, and is most siliceous in the widest parts, but contains in some places 50 per cent. of iron ore. A little limonite, younger than the silica, also occurs here, but the granular iron-ore is quartz-veined, and therefore older. Other crops occur to the north-north-east, connecting this with Mount Leviathan.

A rough computation of the ore above the flats places it at a little less than 9,000,000 tons. This assumes that the whole of the

* E. and M. Jour. 23/3/07, p. 583. F. I. H. Merrill.

mountain is iron ore, and takes no account of the fact that a great proportion is too highly siliceous to be looked upon as a source of iron at the present time.

Pisa Hill.

Pisa Hill lies ¼ mile south-south-east of the main Great Australia crop, above which it rises nearly 100 ft., its total height above the township being somewhat over 150 ft.

The upper part of the hill for 30 ft. from the summit is formed of dense iron ore—the southern part of a crop, 7 ch. in length and 70 ft. in greatest thickness. The crop ends abruptly at the south within a chain of the summit of the Hill, but to the north-north-east (the direction of strike) the deposit tapers slightly.

The main part of the crop consists almost wholly of crystalline hæmatite, with a very small amount of quartz. Northwards the ore is rather softer and less pure, but it is still high grade, with the exception of about a chain's length at the extreme northern end, which is very siliceous, containing 25% granular quartz, probably an original constituent.

Some of the ore is strongly magnetic, some only slightly so and some is quite non-magnetic. It shows internal slickensides, which may be either those of the original slates or, more probably, have

Fig. 6.—Pisa Hill, seen from the north.

been produced owing to the growth of the ore-body by replacement of the original country. In appearance they much resemble those so commonly seen in chromite deposits.

Soldier's Cap.

A crop of ironstone, comparable in size with Pisa Hill, lies 1½ mile south-east from M.L. 487 (Mount Wheeler). It was not visited, but is visible from the Mount Wheeler leases.

Slaty Creek.

A few chains east of the Timberoo lease three outcrops of hæmatite are to be seen. The southern crop is ½ ch. in length and up to 2 ft. wide, and is separated by only a few feet from the central crop, which is 1 ch. in length and 5 ft. in greatest width. The northern crop is ¼ ch. long and 5 ft. wide. The hæmatite is very fine grained, crystalline, and slightly magnetic.

The country is schist except at the southern end, where there is a crop of diorite. The iron ore appears to have replaced the igneous rock where schistose, for such structure is distinctly visible in hand specimens, the felspars only being unaffected.

Duck Creek.

Micaceous hæmatite occurs in bunches in calcite at the Belfast. (Q.v., Part II.)

Palmtree.

Black Mountain is six miles south of the Native Companion, and can be seen from near that mine. The main crop, stated to be dense hæmatite, is reported to be 100 yds. wide and 500 yds. long, and it rises several hundred feet above the level country.

Crusader.

Small bodies of hæmatite were noticed at the Crusader. (Q.v., Part II.)

Hampden.

Magnetite is reported to occur at Mount Sylvia. (*See* Hampden, Part II.)

Florence.

Turgite has been described as occurring at the Trump. (Q.v., Part II.)

Hæmatite was seen at the Dandy. (Q.v., Part II.)

Chinaman Creek.

A small crop of hæmatite occurs on the Thistle. (Q.v., Part II.)

Mount Oxide.

Two of the crops of iron ore, mentioned in Part II. of this report, occur in the north-eastern part of M.L. 282. The main crop extends westwards from the Caves to within a chain of the northern shaft on

the shear-zone. On the eastern side of the lease it spreads out north-westwards for 2 ch., where it becomes very impure, being practically simply a ferruginous siliceous slate. A chain to the north is the third crop, which is impure and not of any considerable extent. It rises to within 10 ft. of Camp Peak, the highest point on the line, and 250 ft. above the Caves.

The largest ironstone crop is that at the Caves (in Mount Oxide No. 1 East) on the western side of Cave Creek and east of Mount Oxide. Its width, just above the creek, is 100 yds., but the country for a chain beyond to the north is very ferruginous, and may possibly be cupriferous at a depth. Westwards the crop, which towers 100 ft. above the creek, contracts somewhat to a width of two chains at five chains from the shaft, and then spreads out obliquely for 5 chains to the north-west. Across the creek to the east there is little sign of iron ore, its absence being due to the occurrence of a big north and south fault near the creek, the continuation of which to the south is indicated by the abrupt discontinuity of the outcrops of the strata.

The iron ore consists in great part of earthy turgite, which has replaced slightly contorted clay-slates, but crystalline hæmatite occurs in considerable quantity, especially in cavities and between laminæ and bedding planes. The unequal hardness of different parts of the body has caused it to weather most irregularly, with the production of many caves and shelters. In these caves slight and doubtful traces of copper stains can occasionally be seen. The dip of the original sedimentaries can be made out in the cliffs at about 45° to the south.

The frequently loose and cellular nature of the ore, together with the green stains, points to the former existence of copper-bearing sulphides in it, the present barrenness being due to leaching, wherefore there is some slight hope of rich ore being found on sinking in the deposit. The easiest way of testing it would be by an incline from the Caves.

Before attempting to account for the genesis of the iron ore, some mention should be made of an occurrence at the Mount Lyell Copper Mine in Tasmania. (See below). Professor Gregory would seem to believe it possible that ferric oxide, only slightly hydrated, may be produced by the oxidation and dissolution of pyrite, under certain not well understood conditions. This, however, is contrary to the general belief, experiments demonstrating that limonite is the result of the oxidation under normal conditions.

The situation of the iron ore-bodies, between the shear-zone and a fault, is significant as indicating that the metal-bearing solutions made use of them as channels in rising.

My sample from the whole width (100 yds.) of the crop at the Caves consists of amorphous, purplish-red, laminated turgite, and

crystal plates of hæmatite in films and bunches between laminæ. There is a little contorted kaolinised slate, in process of replacement by iron ore, which, with the laminated character of the mass, indicates its origin to have been by metasomatic interchange. Some of the ore has a decidedly gossany appearance, and minute traces of copper can be determined chemically in picked pieces, while an occasional speck of malachite may be detected on close inspection. No free silica is present. The following is the result of analysis (Government Analyst):—

Total Fe = 51·30%		
SiO_2 = 15·90	Gold = 20 gr. per ton.	
S = 0·46	Silver = 2 dwt. per ton.	
P = 0·08		
Cu = nil		

Occurrences Beyond Queensland.

Tasmania.

In connection with the widespread occurrence of hæmatite bodies in the Cloncurry district, the first reference should be to that at Mount Lyell; but, unfortunately, no satisfactory theory of the genesis of the latter has been offered.

Prof. Gregory, the last to write on the field,* says:

> It is of course obvious that the Iron Blow was not formed by the simple alteration of the pyrites by surface water and air; for in that case the iron would have been present as a hydrous oxide of iron, such as limonite, instead of as hæmatite. It is accordingly most natural to regard the Iron Blow as some type of lode formed under conditions which have lead to the deposition of red hæmatite from iron solution. . . The iron was probably leached from pyrites in the underlying rocks, and was precipitated along the fault lines, where the ascending waters, containing iron salts, met other solutions which had worked their way downward through the conglomerate.

Wyoming.

There are here† metamorphosed and mashed pre-Cambrian sedimentary and igneous rocks—siliceous limestones, mica-schists, altered sandstones, and gabbros, diorites, and altered porphyries (the last group producing hornblende and chloritic schists), and intrusions of granite, followed by aplites and pegmatites.

Iron ore deposits are found in schist above limestone, the ore replacing schist. The lenses are irregularly elongated parallel to the strike of the metamorphic sedimentary rocks in which they occur, from a few feet to 100 ft. or more wide, and up to 1,000 ft. in length, and proved to 900 ft. depth.

The chief ore is hydrated hæmatite, and the gangue minerals are calcite, quartz, gypsum, chalcedony, biorite, and a kaolin-like mineral,

---

* The Mount Lyell Mining Field, Tasmania, with some account of the geology of other pyrite ore bodies. By J. W. Gregory, D.Sc., F.R.S., etc., Melbourne, 1905.

† Hartville Iron-ore Range, Wyoming. By Sydney H. Ball. U.S.G.S. Bull. 315, p. 190.

with copper ores. The ore probably averages 60 per cent. iron. The iron was deposited by descending water, and was derived from magnetite and pyrite of the schist above (dissolved as carbonate).

GOLD ORE DEPOSITS.

Mr. Jack* describes the occurrence of gold in association with copper at the Flying Dutchman, and with calcite and chalybite at the Uncle Tom Mines (Pumpkin Gully); with native bismuth at the Mary Douglas (Top Camp); with mundic at the Gilded Rose (Bishop's Creek); and with calcite at Weatherley's (Weatherley Creek).

Mr. Rands, in a later report,† gives additional information on some of the above, and besides full descriptions of the Bowerbird, Soldier's Cap, and Bell's Camp fields, and the Last Call Mine.

Very little gold-mining has been done since Mr. Rands's visit, and no examinations were made by me, but several references to the occurrence of gold will be found in the former portions of this report.

* G.S.Q. Publication No. 136.

† G.S.Q. Publication No. 104.

By Authority: George Arthur Vaughan, Government Printer, Brisbane.

Queensland.

DEPARTMENT OF MINES.

Queensland Geological Survey.

(B. DUNSTAN, GOVERNMENT GEOLOGIST.)

PUBLICATION No. 215.

CLONCURRY COPPER MINING DISTRICT.

PART 2.

WITH 1 MAP, 76 PLANS, AND 25 FIGURES.

BY

LIONEL C. BALL, B.E.,

ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE:

BY AUTHORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET.

1908.

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ERRATA.

Page 12.—Above **Labour Victory (R.C. 29)** *read* Agate Downs Group.

Page 17.—On Plan of Duchess and Ivanhoe Groups, for No. 3 on M.L. 427 *read* No. 2.

Page 103.—For M.L. 161 *read* M.C. 161.

Frontispiece.—There is insufficient evidence to warrant the inclusion of the three patches of Desert Sandstone (marked with a query) between Mount Oxide and Kamileroi, and they should therefore be omitted.

Frontispiece.—An area of granite about 15 miles long and 10 miles wide should be shown between the heads of the Dugald River and Cabbage-tree and Prospector Creeks.

GEOLOGICAL SKETCH MAP
OF THE

CLONCURRY COPPER MINING DISTRICT

SHOWING THE PRINCIPAL GROUPS OF HOLDINGS
(To accompany Geological Survey Publications N°215)

by
LIONEL C. BALL B.E
Assistant Govt Geologist

1907

Scale 18 Miles to an inch

Drawn at the Geological Survey Office, Brisbane, Queensland

REFERENCE

- Desert Sandstone (Upper Cretaceous) shown thus ..... D
- Rolling Downs (Lower ") " " ..... K
- Schist, Quartzite & Limestone of undetermined age " " ..... Q
- Granite ..... G

- Mineral Leases & Freeholds .....
- Roads & tracks .....
- Gold & Mineral Fields boundaries .....

Mount Gordon Group
MOUNT OXIDE
Mount Oxide Group
Mistake Ck
Gunpowder Ck
Big Ben GUNPOWDER Group
CREEK
Surprise Creek
Gidya Creek
BOWER BIRD GOLD FIELD
Kamaleroi
LEICHHARDT RIVER
Pigeon House Mtn
Mt Drohedary
DISMAL CREEK
Crocodile Ck
DONALDSON
Eclipse Group
Boundary Group
Dobbyn Group
COOLULLAH
Crusader Group
Warwick Castle Group
Mighty Atom Group
LEICHHARDT RIVER
Mount Cuthbert Group
Centipede Group
PROSPECTOR
Mount Metallic Group
CREEK
DUGALD RIVER
Longamundi Group
Mount Remarkable Group
Lady Clayre Group
Una Group
GLENROY
Hamilton Ck Group
PALMTREE CREEK
CAMERON RIVER
Argylla Group
ARGYLLA
CAMERON
Mount Lloyd Group
RIVER
Rocklands Group
CLONCURRY
MORRIS CREEK
Mt Lidster Group
Sunset Group
Enquiry Group
CLONCURRY MINERAL FIELD
CORELLA
Rosebud Group
RIVER
Timberoo Group
SLATY Ck
Elder Group
ELDER Ck
Mountain Home Group
Roberts Ck Group
Wee Macgregor Group
Springs Group
Lady Group
DUCK
Daisy Group
CREEK
Hilda Group
MARADAH
Eva Group
Leviathan Group
SOLDIERS CAP
Mt Wheeler Group
MALBON
Pindorah Group
RIVER
Just in Time Group
MARTIN
Mt Mc Cabe Group
CREEK
Mt Hope Group
WILLS RIVER
Lady Fanny Group
FLORENCE
Florence Group
RIVER
Hampden Group
HAMPDEN
Monitor Group
Ivanhoe & Duchess Group
Mt BURKE
RIVER
Horse Creek Group
HORSE CREEK
MAGGIES
Labour Victory Group
Mt Elliott Group
CREEK
Pilgrim Group
PILGRIM
Trikelana Group
CREEK
MOUNT BIRNIE
MORT RIVER
Cattle Ck
CORELLA RIVER
Gipsy Ck
Dalgonally
Julia Creek
Tommy Creek
CLONCURRY RIVER
Courtenay Creek
Fishers Ck
PUMPKIN GULLY
Homeward Bound Group
TOWN
Lady Mina Group
GILLIAT
WILLIAMS RIVER
Eastern Branch
Gorge Creek
LEICHHARDT RIVER
FULLARTON RIVER
McKINLAY RIVER
Bull Creek
Gidya Creek
Ratchitto Creek
Nora Creek
McKINLAY
BORE
Boorama Creek
Limestone Creek
BURKE RIVER
WILLS CREEK
Sandy Ck
Roseland Ck
Q?

CLONCURRY COPPER MINING DISTRICT.*

PART II.

MINERAL HOLDINGS.

This part of the report is limited to individual descriptions of the mines, all other matters having been considered in the first part.

Though the whole country has been divided into counties, parishes, runs, and blocks, these divisions are seldom made use of in locating the mines. Locally, each part of the district is known by the name of some natural feature, such as a mountain (Soldier's Cap) or a river (Corella), or by that of a settlement (Hampden). In describing the mines it is usual to refer those on a single lode or within a circumscribed area to a single group. The local nomenclature, where consistent, has been followed in this report in the naming of districts and groups, the former coming below in their order from south to north.

The leases and freeholds mentioned below have been located on a map of the Cloncurry district published with the Annual Report of the Under Secretary for Mines for the year 1906;† and most of the groups are shown on the small map attached.

*This report has already appeared in the *Queensland Government Mining Journal* of June, 1907, *et seq.*, but has been rearranged for this publication, in which will also be found some additions, chiefly of mineral holdings not visited by me.

† Later issued as G.S.Q. Publication No. 213.

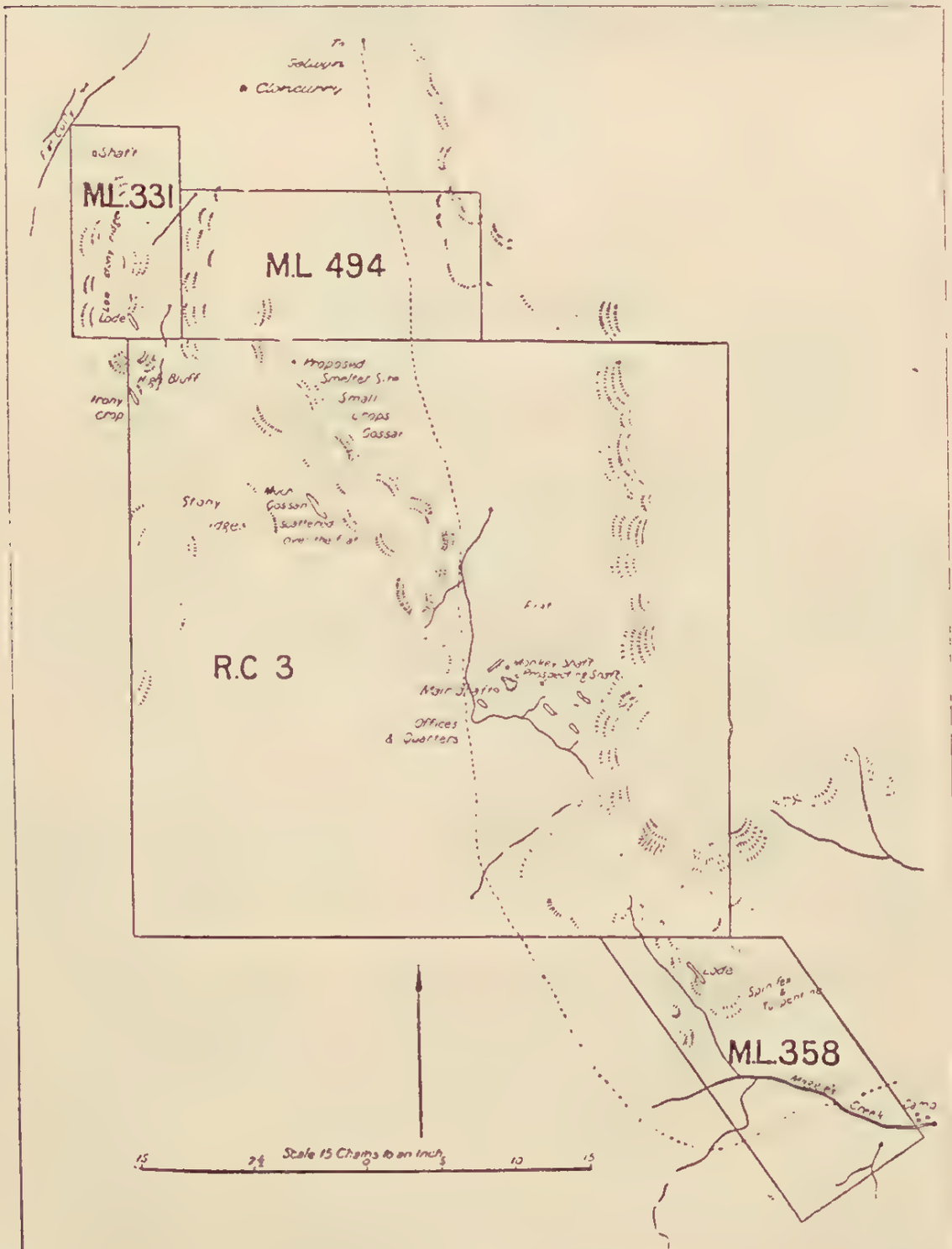
MAGGIE'S CREEK.

Maggie's Creek, which rises on the low divide, known as the Selwyn Range, has a run northwards into the Cloncurry River of little over ten miles.

The only mines working at the end of the year 1906 were the Mount Elliott and the Labour Victory.

MOUNT ELLIOTT GROUP.

The Group includes reward claim No. 3 and mineral leases Nos. 331, 358, and 494.



SKETCH PLAN, REWARD CLAIM AND LEASES, MOUNT ELLIOTT.

Mount Elliott (R.C. No. 3, Etc.).

(Mgr., G. A. Waller).

Location.

The claim and leases are located on a low divide between two of the upper branches of Maggie's Creek, a short tributary of the Cloncurry River, 58 miles south of Cloncurry and 1,400 ft. above sea level.

The new township of Selwyn has lately been laid out, ½ mile north of the workings.

The mine is connected with Cloncurry by a good road running down Maggie's Creek, across the Cloncurry River, into Hampden; then across the Florence River and down the Cloncurry River (crossing it twice) to the township. An alternative route (but now seldom used) is down the Cloncurry River, *viâ* Devencourt, across the Dugald River to Duck Creek.

The latest proposed tramway route from Mount Elliott leaves the coach road at the Florence, and makes a slight detour to the westward to take in the Duck Creek group.

Topography.

The Mount Elliott divide crosses a shallow valley carved out of an old pene-plain, of which only flat and topped ridges and hills, rising 150 ft. above the present valley bottom, now remain. The strata for some depth below the surface of the old pene-plain have been rendered very ferruginous, and are especially subject to irregular weathering, allowing the formation of caves.

Mount Elliott, being near the divide, is one of the driest localities of the district, and it has been necessary to devise methods of water conservation to ensure the successful exploitation of the mine. One of the first proposals was to pump water from a well at the Boomerang waterholes, six miles down Maggie's Creek. It has also been proposed to construct a dam in one of the gorges at the head of Maggie's Creek, but the present supply, which is believed to be sufficient, is obtained from two wells a short distance south-east of the mine.

History.

During the second quarter of 1901 Mount Elliott was placed in the hands of a Melbourne Option Syndicate, who sank a shaft 50 ft. and, by crosscutting during the third quarter, proved 37 ft. of solid ore—at a cost of £6 per foot.

In the following three years little was done beyond well sinking, but toward the end of 1905 the shaft was deepened to 100 ft.

The Linedale Syndicate then secured a working option for 12 months, and early in 1906 a company was floated in Melbourne. Extensive developmental work was at once begun, and carried on till

the end of the year. The unusually complete surface plant necessary in so remote a locality is now in full working order, and the erection of a smelter is being proceeded with.

From the manager's reports published in the Brisbane Press since my visit, the following has been culled:—

22/2/07.—Western crosscut at 185 ft. level back from No. 1 winze (below No. 2 crosscut) advanced 18 ft. in sandstone, with iron pyrites in the end, and a lode formation 2 ft. wide, with veins of rich ore 6 in. wide (footwall lode?).

No. 2 inclined shaft opencut 19 ft. deep.

2/3/07.—Footwall veins struck at 32 ft. in crosscut from main shaft at 185 ft. level 4 in. to 2 ft. wide—40% copper.

Hard ferruginous ore struck in crosscut at 23 ft. from the No. 1 winze—4% copper

15/3/07.—Low grade gossan struck at 40 ft. in crosscut from main shaft at 185 ft level—4 ft. 6 in. wide.

Footwall vein in north-western drive 4 ft. wide—45% blk. oxide and glance.

No. 2 inclined shaft 40 ft. deep.

29/3/07.—Main ore body cut in north-western drive (total 17 ft.) on 185 ft. level at 10 ft. from the shaft—7% copper.

27/4/07.—Footwall vein in 185 ft. level main crosscut composed of kaolin, with two principal bands of rich glance, totalling 4 ft. in thickness, and averaging when bagged 41% copper, but pinched out northwards in 15 ft. Crosscut then put across the lode to connect with No 1 winze, proving main ore body to be 18 ft. wide, and proved for 30 ft. north-west from the main crosscut. [Mr. Waller kindly sent me this information.]

1/5/07.—North-west drive (125 ft. level)* 30 ft. long in hard ferruginous ore, containing 2% Cu.; 9 ft. drive on hanging-wall kaolin.

Unfortunately my visit was a hurried one and made during Mr. Waller's absence, and consequently without his guidance and local knowledge. His officers, however, gave me every facility in making the examination.

Literature.

The full titles of the reports, numbered as below, will be found in the Introduction.

4. Mr. Cameron refers briefly to Mount Elliott, the only work done at the time of his visit being the two trenches at opposite ends of the main crop. He however, considered the crop worth testing by adits.

10. Mr. Waller, in his first report, goes fully into the general description of the property, including locality, geological features, work done, probable ore available, water supply, &c. The only workings described are those connected with the prospecting shaft; but, taking the area of the crop as 3,600 sq. ft., and knowing the ore to bulk 11 cub. ft. to the ton, Mr. Waller computes the probable ore above the 127 ft. level as 40,000 tons, of an average value of 20 to 25% copper.

14. In his second report Mr. Waller fully describes the workings. His resampling gives slightly different results to those first obtained, and he now estimates the average contents as 16·4% copper and 2 dwt.

* Meant for 185 ft. level? L.C.B.

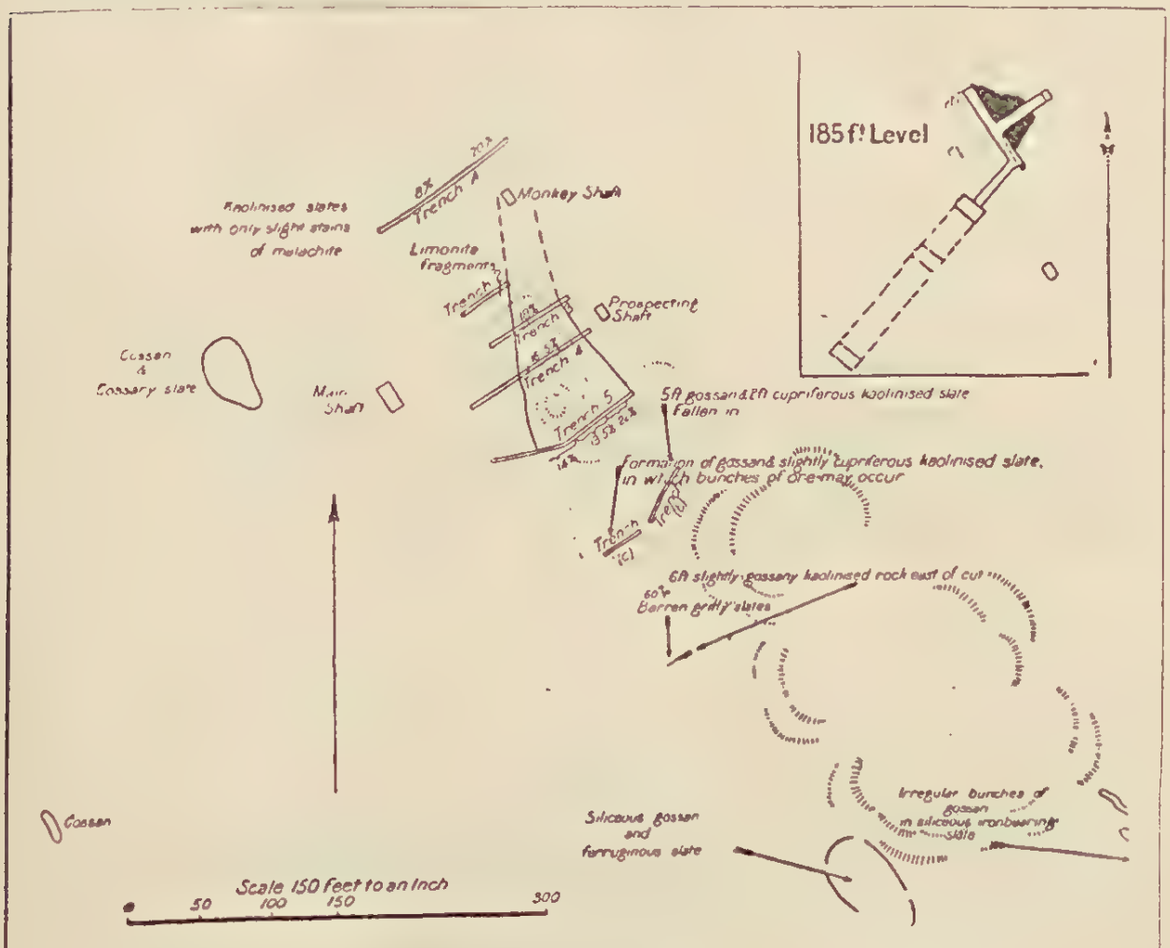
gold per ton, but the additional work done allows him to calculate the ore in the main body above the 125 ft. level as 45,000 tons. This, however, appears to only partly include the rich kaolin ores referred to.

Area.

Reward Claim No. 3 on which the workings lie is square and 160 ac. in area. Mineral Lease No. 331 of 10 ac. at the north-western corner of the reward claim and M.L. 358 of 20 ac. at the south-western corner were taken up on the line of strike of the ore bodies. M.L. No. 494 of 20 ac. has been secured as a works site.

Development.

The north-western trench (No. 1 or *a*) is 20 ft. north-west of the monkey shaft, and is 1 ch. in length.



SKETCH PLAN, SURFACE AND 185-FT. LEVEL, MOUNT ELLIOTT.

The following four trenches have been opened since my inspection:—

No. 2 trench, 50 ft., south-east of No. 1 is 30 ft. long.
No. 3 trench, 20 ft. beyond, is 50 ft. long.
No. 4 trench, 25 ft. beyond, is 70 ft. long.
No. 5 trench, 35 ft. beyond, is 90 ft. long.

The eastern trench (No. 6 or *b*), 35 ft. long, about 10 ft. east of the main crop.

The south-eastern (*c*) trench, 25 ft. long, is 6 ft. south-west of the eastern trench.

The southern trench (*d*) is 1 ch. to the south-east of the trench (*c*).

The prospecting shaft is 125 ft. east of the brace of the main shaft. It is vertical to the 125 ft. level, and then follows the underlying footwall to the 212 ft. level, where a crosscut was put in 16 ft. to the north-east. Its total depth is 227 ft. There are also at the 50 ft. level crosscuts north-east and south-west 6 and 52 ft. respectively.

The monkey shaft is 70 ft. north-west by north of the prospecting shaft. It is vertical to the main drive on the 125 ft. level.

The main shaft (5 ft. x 10 ft. clear of timber and three compartmented) has been sunk 197 ft. in the footwall with an underlie of 60°. At 121 ft. below the brace a main crosscut, 45 ft. in length connects with the main drive, known as the 125 ft. level. This drive is 172 ft. in length, and from it four crosscuts have been opened to the north-east. No. 1, 54 ft. in length, is 40 ft. south-east of the main crosscut; No. 2, 60 ft. in length, is 30 ft. north-west; No. 3, 50 ft. in length, is 100 ft. to the south-east; and No. 4, 65 ft. in length, is 65 ft. north-west. A branch drive 27 ft. long and known as the western (west 10° north) drive, leaves the main drive 60 ft. north-west of the main crosscut. It is next proposed to open out at the 168 ft. level.

Mr. Waller proposes to work the deposit by open cut to a depth of 125 ft., more especially owing to the scarcity of timber—an expensive item in any other system of mining. Another inclined shaft is to be sunk, and by it the ore will be raised to the smelters to be erected on the hill to the east of the mine.

Output.

Total, 1906—182½ tons.

Main Ore-bodies.

The main outcrop, which rises abruptly 20 ft. above the surrounding flats, is 60 ft. in width at the southern end, and gradually tapers northwards to 20 ft. in a distance of 90 ft. (exact measurements are not possible because of a covering of loose talus).

The ore looks rather siliceous externally, but is found on breaking to consist of limonite (passing into red jasperoid), both barren and with disseminations and minute veinlets of cuprite and malachite, the former sometimes dendriform and the latter chiefly as amorphous encrustations. A little chrysocolla is found in cavities, and atacamite crystals are dusted over crystallised calcite on cracks in the limonite from the prospecting shaft. The presence of gold has been proved by assay, and one speck was noticed embedded in cuprite in a specimen collected by me. Some chalcedonic silica occurs as linings on joints, stalactitic in places, and also as radiating bunches and veins easily

separable from the limonite. The comparative youth of these siliceous deposits is shown by their having been precipitated round stalactites of chrysocolla (Fig. 1), which must have leached out of the gossan, and

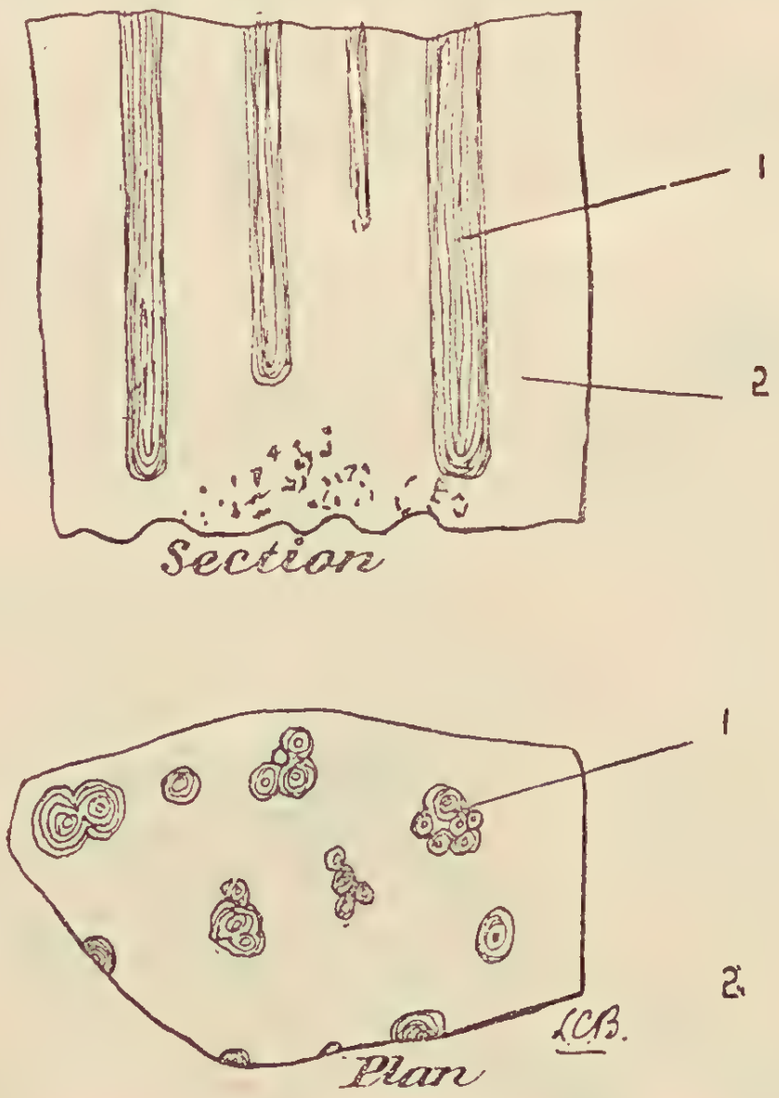


FIG. 1. (NATURAL SIZE)—SECONDARY ORE, MAIN CROP, MOUNT ELLIOTT.

(1). *Stalactitic chrysocolla.*
(2). *Chalcedony enclosing chrysocolla.*

their chalcedonic nature is indicative of their having been deposited within the zone of weathering. The crop has been trenched since my visit, and samples have been assayed as below:—

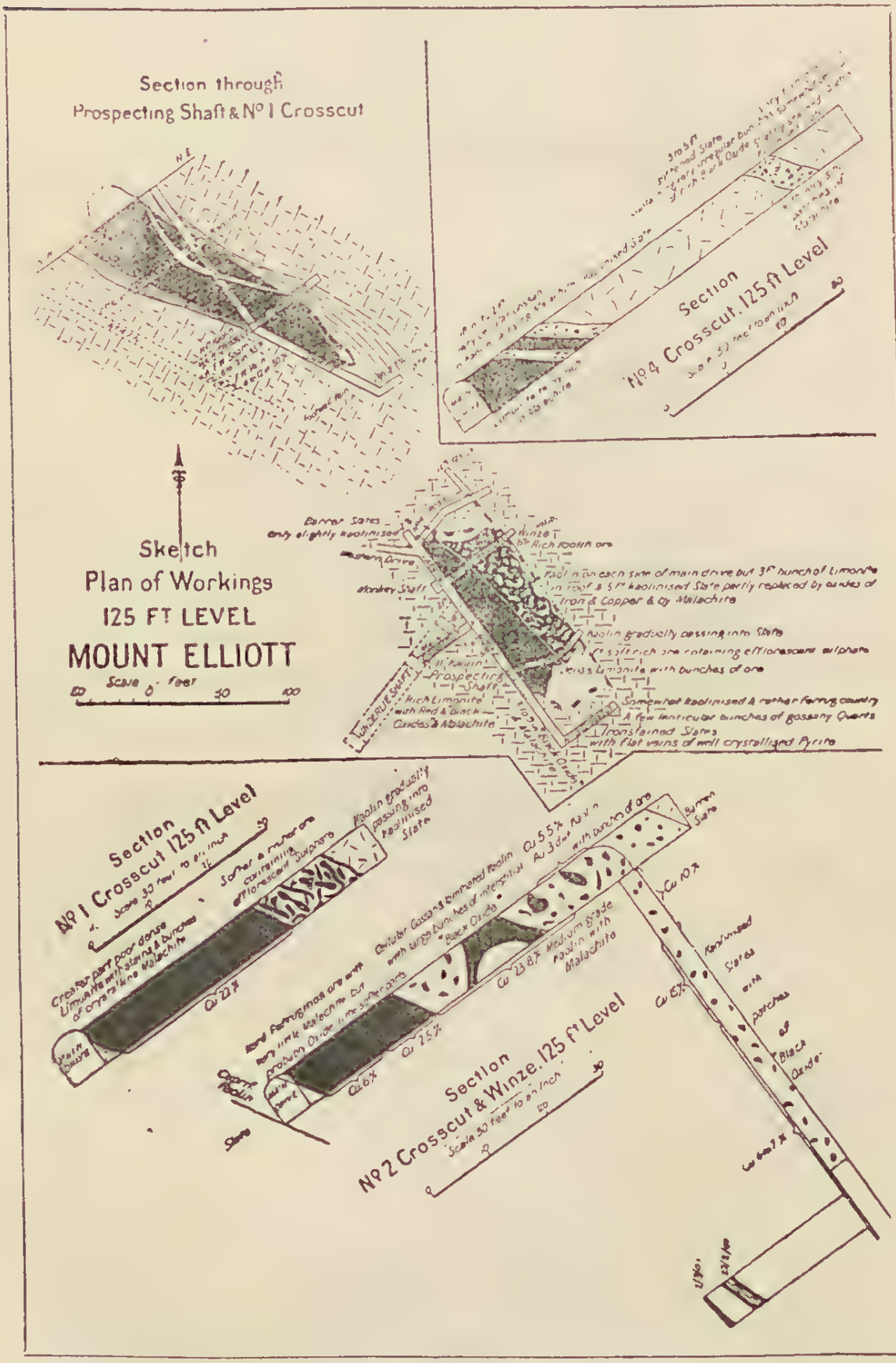
No. 3 trench, 30 ft. width of ore—
Copper 18% and gold 3 dwt. per ton.

No. 4 trench, 40 ft. width of ore—
Copper 16·5% and gold 2 dwt. per ton.

No. 5 trench, 58 ft. width of ore at southern end of crop—
Copper = 15·2% and gold = 2 dwt. per ton.

The prospecting shaft, which was begun in the hanging-wall country, was inaccessible to me, but from Mr. G. A. Waller's reports

it is understood that the ore-body was cut at 40 or 70 ft. (it is not quite clear which) below the surface, and the footwall kaolin at 115 ft. The ore in the shaft averages 17·8% copper, with a trace of gold. Crosscuts at the 50 ft. level prove the body to be there 55 ft. wide, and to carry 15% copper, with 3 dwt. gold per ton. The crosscut at



the 212 ft. level proves only slates, carrying iron pyrites, and is believed to be beneath and to the south-east of the north-westerly pitching ore shoot. The ore at grass is chiefly a very dense brown limonite, stained by chrysocolla and dioptase, and with thin veins of silica. Calcite is sometimes crystallised in cavities lined with drusy quartz.

The monkey shaft, also inaccessible, was sunk in hard limonite to 80 ft., where it entered the footwall limonite. The ore raised yields 16·5% copper and 1 dwt. gold per ton. The whole of the tip, some 700 tons, appears to be kaolin impregnated with malachite and gossan veined with the same mineral.

The main drive connecting the prospecting and monkey shafts at the 125 ft. level is in a body of kaolin on the footwall of the lode over the greater part of its length, but at the north-western end only barren slates, giving evidence of much lateral crushing, can be seen. It exposes in several places the footwall vein which from the prospecting shaft to the south-east is 3 to 9 in. thick, and consists of black sulphide and malachite.

The No. 1 crosscut proves 32 ft. of hard ore (dense limonite with stains and bunches of malachite) adjacent to the footwall flucan—assaying 22% copper—followed by 12 ft. of softer ore containing efflorescent sulphate.

No. 2 crosscut proves 15 ft. of hard ore (dense limonite, with very little malachite but some secondary sulphide in the softer parts), averaging 5% copper and gold nil. Beyond this to the face, cellular gossan occurs with large bunches of blue-black amorphous pulverulent sulphide (generally referred to as black oxide) in stained laminated kaolin. The first 25 ft. contains 23·8% copper and 5 dwt. gold per ton, and the remaining 10 ft., 5·5% copper and 3 dwt. of gold per ton.

The winze is sunk in slightly kaolinised slates impregnated with "black oxide," and containing occasional bunches of the same in decreasing quantities towards the bottom, where a little pyrite also occurs on the joints as yet stained by black oxide. Mr. Waller's samples are: for the uppermost 10 ft., 10% copper; the next 15 ft., 15% copper; and the remaining 35 ft., 6 to 7% copper.

No. 3 crosscut failed to find the ore body, but the iron-stained slates, with flat veins of well crystallised pyrite, are giving way in the face to more ferruginous and kaolinised country, and continuation of the crosscut may result in the discovery of at least a branch of the ore-body. The crosscut, however, must underlie the greater part of the ore shoot.

No. 4 crosscut was begun in limonite fairly rich in malachite. At 15 ft. from the main drive there is 18 in. to 2 ft. of very cellular gossan, dipping flatly to the north-east. Adjacent to this, above and below, there is 2 ft. of kaolin, with patches of malachite and tile ore; and beyond, slate to within 12 ft. of the end of the crosscut; then

3 to 5 ft. of softened slate, containing very irregular bunches of rich secondary sulphide; and this is followed by slightly stained kaolinised slates (say, 2% copper), the country in the face being very ferruginous and somewhat cellular, with very small patches of malachite. This also should be further prospected.

The western drive, when seen by me, was only 6 ft. long, in rich oxide and carbonate ore, with bunches of red jasperoid, probably averaging 20% over a width of 10 ft. It has since been proved that the ore pinches out 17 ft. from the main drive.

The footwall seam was first struck in the prospecting shaft between the kaolin and slate, at the 125-ft. level, where it consisted of black ore, 6 in. to 12 in. wide, containing 35% copper. Its average width on the 125-ft. level is 2 ft., and its composition as given above. It has been proved for 46 ft. below the 125-ft. level to average between 25 and 35% copper, and to vary between 3 in. and 15 in. in thickness, but pinching below to 1 in.

In trench (*a*), to the north-west of the crop, only kaolinised slates, with slight stains of malachite, can be seen. Mr. Waller sampled this, and found 60 ft. to average 8% copper and 10 ft. (hard ore) 20%.

In No. 2 trench, also to the north-west of the ore-body, 12 ft. of cupriferous kaolin has been exposed.

Trench (*b*) shows 5 ft. gossan and 2 ft. cupriferous kaolinised slates; and in trench (*c*) there is a formation of gossan and slightly cupriferous kaolinised slate, in which bunches of ore may be found.

Trench (*d*) shows only barren, gritty slates, but at the eastern end 6 ft. slightly gossany kaolinised rock can be seen. This becomes more gossany towards the south, and at 1 ch. from the trench is 3 ft. wide.

Detached Ore-bodies.

Besides the main crop, there are several other smaller ones, any of which, on opening up, may prove to be as productive as that now being exploited. A comparatively small crop of rather siliceous quartz-bearing gossan is to be seen 2 ch. south-east of trench (*d*). Including ferruginous country, it is 20 ft. wide, and it is at least a chain long.

East of the last about 2 ch., several irregular bunches of gossan occur in silicified iron-bearing slate, which represent bunches of ore. There would seem to be no continuation of the ore-bearing zone southwards, for only a chain away from the last barren thin-bedded blue slates, dipping steeply to the north-east, are exposed in a low precipice.

Other crops of gossany ore and slate that require to be opened up lie 2 ch. south-west of the northern end of the main crop and 5 ch. south-west of the southern end.

Much gossan occurs scattered over the flat about 15 ch. north-west of the main crop. This should be prospected, as it is apparently on the line of strike of the main lode.

Some trenching ¼ mile north-north-west of the mine has revealed silicate ore in speckled schist, with small patches of gossan.

Ore Reserves.

The latest estimation of the amount of ore proven above the 125-ft. level is that by Mr. Waller: 45,000 tons averaging 16·4% copper and 2 dwt. gold per ton. This refers only to "hard ore," similar to that in the main crop, the large bodies of kaolin ores being omitted because of their irregular development and the small amount of work done on them.

As to ore below the 125-ft. level, there is every probability of the main body pitching to the north-west as first predicted by the present manager, but no work had been done to prove this at the time of my visit. The gossan has been formed from sulphides, which are to be expected below the water-level, and may contain anything from, say, 3% to 30% copper. In the neighbourhood of the water-level there ought, however, to be considerable secondary enrichment, and chalcocite and cuprite may there be found almost replacing the limonite and original sulphides.

Geology.

These ore bodies occur in an area of upturned slates and schists, presumably part of the great province of Cloncurry, which there is some reason to regard as Pre-Devonian. The separate bodies in the vicinity of the main Mount Elliott outcrop make little show above the ground, and cannot be traced for any great distance; yet there is a possibility of any of them increasing greatly in size below the surface.

In my opinion, the ore bodies do not lie on true fissures (extensive dislocations of the crust, allowing relative movements of great masses of country on opposite sides), but follow the bedding of the enclosing strata. The sulphides may have been given off from deep-seated intrusives at the time of their cooling. The bedding planes will have allowed almost as free passage as a fissure, and when precipitation has been brought about at any point from any cause deposition is likely to have been continued there by metasomatic interchange with the country rock. In this way may have been formed either a succession of leases or one long pipe (shoot), but which it is can only be proved by sinking. Crushing of the country

may have been caused either by expansion during replacement, or, more likely, in oxidation of the original pyrite and chalcopyrite to limonite, when kaolinisation of the adjacent country took place.

The formation of the kaolin ores would follow the oxidation of the sulphides, kaolin exerting a powerful precipitative action* on the copper-bearing solution leaching from the main body. These rich ores are, therefore, not to be expected below water level, and instead of kaolin there will be barren or, at most, pyritous slates.

Labour Victory (R.C. 29).

Location and Area.

The Labour Victory is located in the southern part of the Agate Downs Goldfield, 53 miles south of Cloncurry.

Its area is 40 ac.

History.

This reward claim was granted in July, 1903, and has been worked spasmodically till the present as the following historical notes show:—

July, 1903.—Reward Claim granted and ore being raised.
Jan., 1905.—Work resumed.
Mar., 1905.—Shaft 35 ft. deep; lode 4 ft. wide.
Sept., 1905.—Shaft 52 ft. deep and new shaft started.
Feb., 1907.—Syndicate formed. Total of 85 tons ore obtained.

Development.

The workings include a trench 6 ft. deep and 20 ft. long at the north end, besides one or two other shallow cuts; two potholes 8 ft. and 10 ft. deep, respectively, 2 and 3 ch. south of the main shaft; an opencut, 20 ft. long and 12 ft. deep, on the southern side of the main shaft; the main shaft 47 ft. deep and 2 ch. south of the northern trench, has a stope running back for 10 ft. south, and a level at 35 ft. depth 25 ft. long with overhead stope 10 ft. high at the shaft; the new shaft 50 ft. to the north of the main shaft and 47 ft. deep; and a 12 ft. pothole adjacent to the quartz crop 15 ft. east of the last.

Output.

1903—	$7\frac{19}{20}$ tons	44%	copper and 6 dwt. gold per ton.
	3 ,,	35%	,, ,, 3 ,, ,, ,,
	5 ,, (seeds.)	22%	,,
1904—	18 ,,	30%?	,,
1905—	13 ,,	41%	,,
	20 ,,		
	35 ,,		
1906—	$78\frac{19}{20}$,,		
	180 tons	over 35%	,,

*Absorption. By Walter H. Weed and E. Kohler, "Engineering and Mining Journal." 23/2/'05. Also, Precipitation of Copper by Natural Silicates. By Eugene C. Sullivan. "Economic Geology." Vol. I, No. 1.

Ore-bodies.

There appear to be at least three overlapping and nearly parallel lines here, but the only body of copper ore of any size is that at the main shaft. This may yet be proved to increase in size in depth but the present exposure warrants energetic development.

In the northern trench is an 18 in. nearly vertical body of limonite and quartz carrying bunches of ore. The strike is like that of the country rock here only slightly altered.

Half a chain south of the cut there is a crop of gossan apparently on the continuation of the above body, which has not been proved further south.

Just to the north of the new shaft is a blow, a chain long and up to 6 ft. in width, of limonite and quartzite—probably the cap of a rich siliceous pyritic lens.

The new shaft was sunk in kaolinised slates on, it is reported, a 2 ft. seam of quartz. There is only about a ton of ore at grass, consisting of a mixture of earthy black oxide and green carbonate of copper.

The 12 ft. pothole was opened on the eastern side of a quartz blow, but there is no justification for its continuation.

The main shaft shows a 5 ft. formation near the surface, but in the southern stope an average of 6 ft. has been removed between the 10 and 35 ft. levels, and even that is not the whole width of ore. In the northern face there is standing 5 ft. of slightly siliceous red ore (tile ore containing much malachite and probably assaying 35% copper) which would appear to be a rich shoot pitching northwards from the shaft, where 46½% ore was broken down. On the west of it is a foot of gossany material, and then kaolin (as on the east, where the schistose structure is discernible). The ore is poorer in the floor of the drive, and is said to have pinched below, in the shaft which was unfortunately inaccessible. The greater part of the ore shipped from the mine has come from this shaft and the opencut to the south. The firsts include an earthy black chalcocite, sometimes irregularly veined and impregnated with acicular malachite and occasionally showing scattered granules of pyrite evidently in process of replacement by the secondary sulphide. The chalcocite sometimes changes imperceptibly into limonite, in which also grains of unoxidised pyrite can be detected. When inspected the seconds at grass amounted to 70 tons, and comprised carbonate in gossan and replacing kaolinised slates, but generally free from silica and probably carrying 20% copper. The heap is made up in part of carbonate veined tile ore, and the precipitative action of clay is clearly indicated by the zone of earthy malachite surrounding fragments of clay slate in the ore. Besides this ore, the "thirds" at grass amounted to 20 tons—dense

limonite, with a slight impregnation of malachite, containing between 10% and 15% copper. Some pyrite is visible in the interior of the limonite blocks raised.

In the southernmost pothole there is 12 to 18 in. of gossan dipping eastwards in green stained kaolinised slate, but only ½ ton of ore has been shipped from here.

In the pothole a chain to the north of this there is under an 18 in. to 2 ft. cap of quartz, an irregular formation up to 5 ft. in thickness, with small rich lenses of gossan and malachite in kaolin (decomposed clay slate).

A small bunch of 37% ore (1½ ton) lay 30 ft. east of the main shaft.

Fluxiana (M.L. 414).

Mgr., G. A. Waller.

Location, Etc.

The Fluxiana is on Cave Mountain, near Maggie's Creek.

Its area is 20 ac. The ground held by the Mount Elliott Company for the supply of flux. It was not visited by me.

Occidental (M.L. 310).

(McEvoy and Leray.)

Location, Etc.

The Occidental is near the Labour Victory.

Its area is 10 ac. It was not visited by me.

Twiggie Vous (Extended M.C. 277).

(Mgr., Bentley.)

Location, Etc.

The Twiggie Vous is 5 miles north of the Labour Victory and ¼ mile off the Devencourt road.

Its area is 1,200 ft. × 350 ft. It was not visited by me.

HORSE CREEK.

Horse Creek also rises on the Selwyn Range, but some miles to the west of Maggie's Creek. Its general course into the Cloncurry River is north-north-westwards.

HORSE CREEK GROUP.

In this group, which lies 50 miles south-by-west from Cloncurry, are included only the leases giving it the name, but it is understood that developments have lately taken place in the neighbourhood on Boomerang Creek. Rich specimens, consisting of chrysocolla in kaolin and of intermixed malachite and tile ore, have been brought to me from the latter locality.

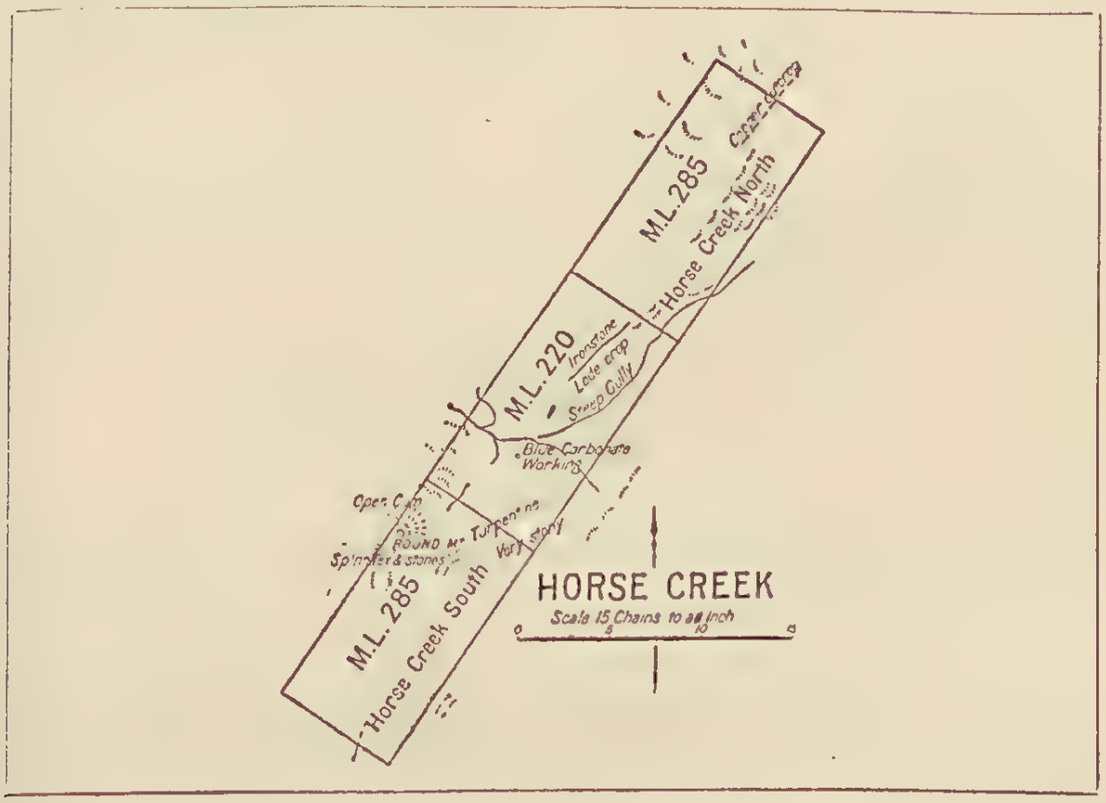
In travelling from the Duchess to Mount Elliott my route took me through Horse Creek country, the mine being missed through incorrect directions having been given me. Topographically the country shows little diversity, there being only slight and rounded rises and shallow depressions. The rocks seen were chiefly silicified slates and quartzites.

Horse Creek (M.L. 220, Etc.).

Mgr., Matheson.

LOCATION.

These leases are located on one of the head branches of Horse Creek, 50 miles south-by-west from Cloncurry, and 3 miles north-east of the south-eastern corner of Devoncourt No. 5 run block. They are about 7 miles from the Devoncourt-Hampden road, and, as work had not begun here and a guide was not available, no attempt was made by me to find them.



Area.

The five leases here, each 10 ac. in area, are Nos. 220, 285 (1 South), 286 (1 North), 559 (2 South), and 560 (2 North). They are the property of the Mount Merlin Copper Company.

Development.

The manager's reports in the Brisbane Press state that 6 men began in January of this year, to open-cut the lode at the northern end of the lease. In April a shaft had been sunk 16 ft.; an old shaft on the No. 1 South was being cleaned out, and in May the vertical shaft was 60 ft. deep.

Output.

1897— 3 tons ... ... shipped by Brady, prospector—47½% copper
1905—13 ,, ...

Ore Deposits.

Mr. Brady, the prospector, informed me that veins of ore occur over a width of 60 ft. in schists. Warden Cherry has stated that the outcrop resembles that at Hampden, and the manager reported: "The main outcrop is a peculiar jumble of schists quartz and kaolin, all more or less heavily impregnated with copper carbonates and red oxide." It is shown on the surveyor's plan running north-east. In February, 1907, the manager reported that there were 70 tons of good quality ore in the paddock. In April, 1907, he reported that the face of the open cut, 10 ft. high and 16 ft. wide, was "showing good bunches of hard carbonates."

At the same time he mentioned that in the ends of an old shaft on Horse Creek No. 1 South, can be seen a 12 in. vein of high-grade ore, and in May that the ore-body to a depth of 60 ft. is quite vertical.

Unnamed (M.L.).

Location.

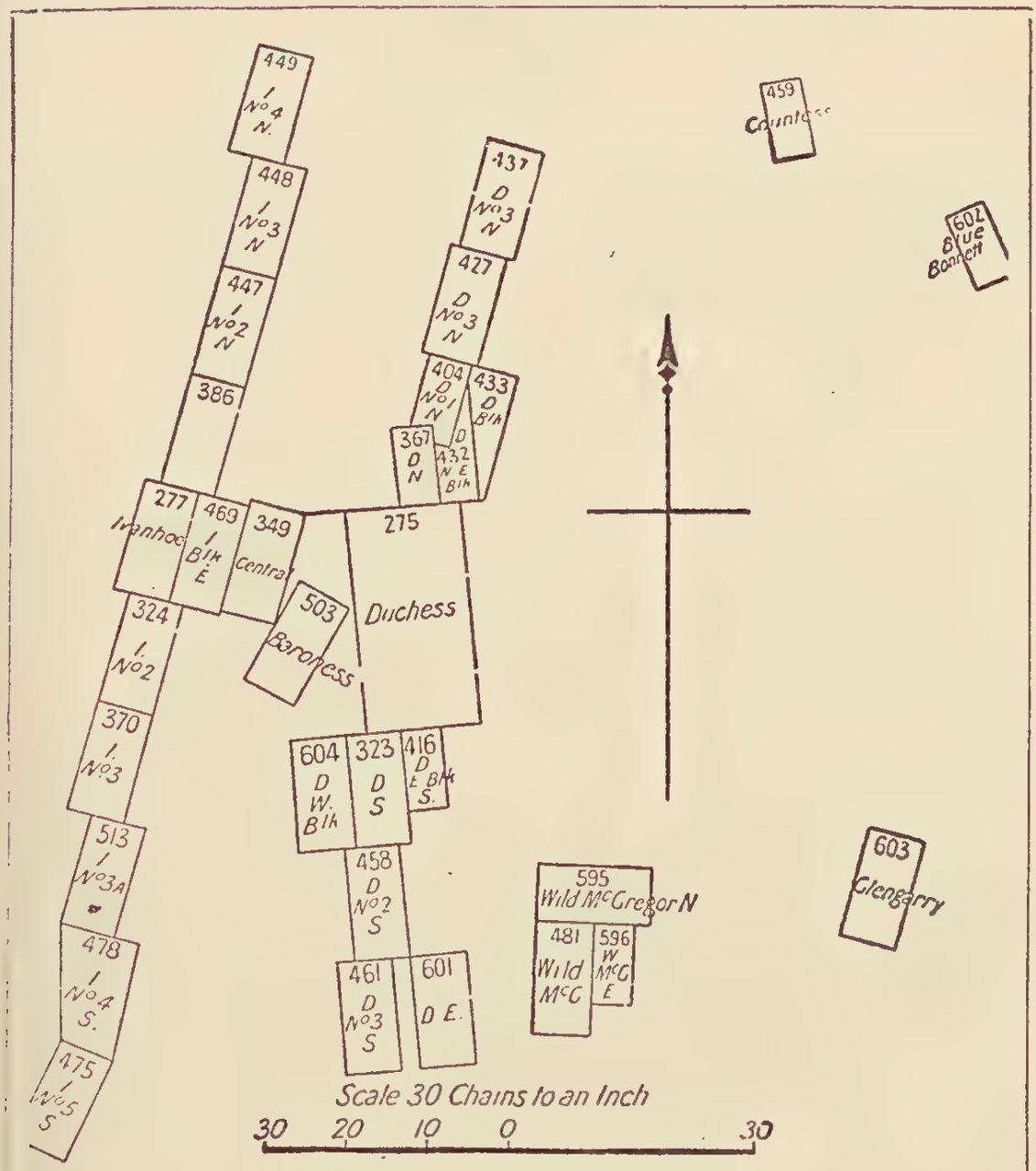
This is on Boomerang Creek, 14 miles from Devencourt.

Ore-bodies.

Chrysocolla in kaolin and an ore consisting of intermixed malachite and tile ore (40% copper) have been shown me from here.

BURKE RIVER.

These groups, which are between 60 and 70 miles south-west of Cloncurry, comprise a large number of leases on the Duchess, Ivanhoe, Wild MacGregor, Pilgrim, and other lines. Reference will be made below only to the principal leases.



DUCHESS AND IVANHOE GROUPS.

Geologically the Burke River district has several points of similarity with the country in the immediate vicinity of Cloncurry—limestones, partially replaced by quartz and iron oxide, occurring under similar conditions in the A1 freehold and on the Ivanhoe (and Pilgrim ?) leases. The beds of indurated felspathic sandstone are, however, characteristic of the Duchess.

DUCHESS GROUP.

The Duchess Group is here made to include besides the Duchess, the Ivanhoe, Wild MacGregor, and others more usually referred to separately. Leases in force on the various lines not here described are shown on the attached plan.

Duchess (M.L. 275).

C. L. Smith—Gen. mgr.

Location.

The Duchess lies on the northern bank of Jack's Creek, one of the upper branches of the Burke River, 61 miles south-west of Cloncurry. The track to the mine leaves the Cloncurry-Urandangi road at a gate 4 miles west of Devoncourt station, the total distance to Cloncurry by road being 73 miles.

It is situated in a nearly flat bottomed north and south valley, with rocky hills on either side.

Area and History.

M.L. 275 has an area of 40 ac., and is the property of the late owners of the Hampden Copper Mines.

In Feb. 1906 the original holders sold the lease for £15,000 to the Hampden-Cloncurry Copper Mines Limited, and since development has been steadily carried on.

Literature.

For titles of reports numbered as below see Introduction.

(4) Under the description of the Pilgrim Creek Leases Mr. Cameron refers to the Duchess thus:

Lease No. 54 shows an outcrop of copper ore on level ground, noticeable as a band of green stained rock of about 80 yards in length and 30 feet in width at the northern end. The ore showing on the surface is chiefly rich glance, considerably weathered to carbonate. Along the western wall the ore is associated with quartz in a vein of a foot or two in thickness, following the bedding of the country rock. The remainder of the lode appears to be an impregnation in a decomposed felspathic sandstone. Samples of the ore gave an assay 46·2 per cent. of copper, a trace of gold, and 4 oz. 12 dwt. 8 gr. of silver per ton. Further south the lode appears to pinch considerably, but is traceable by a line of small patches of quartz and carbonate for the next 30 yards. It shows here as a knob of quartz with copper glance and carbonate about 3 feet in thickness, the total width of the lode being apparently about 6 feet. Some ore picked from here assayed 47·57 per cent. of copper, a trace of gold, and 7 oz. 1 dwt. 3 gr. of silver per on. Forty-four yards further south another outcrop of quartz is seen, and again yards on, a patch, 13 yards in length by 3 feet in thickness, shows copper glance and carbonate. A sample of ore from here assayed 35·2 per cent. of copper, a trace of gold, and 6 oz. 0 dwt. 5 gr. of silver per ton.' The appearance of the outcrop of this lode is very promising, and from what can be observed of the general mode of occurrence of the copper ores in the district, shows a good prospect of being able to turn out a considerable quantity of rich glance ore above the water level. A few shallow trenches and shafts would soon throw light on its probable value.

(7) Mr. Rutherford describes the outcrop, and then continues:

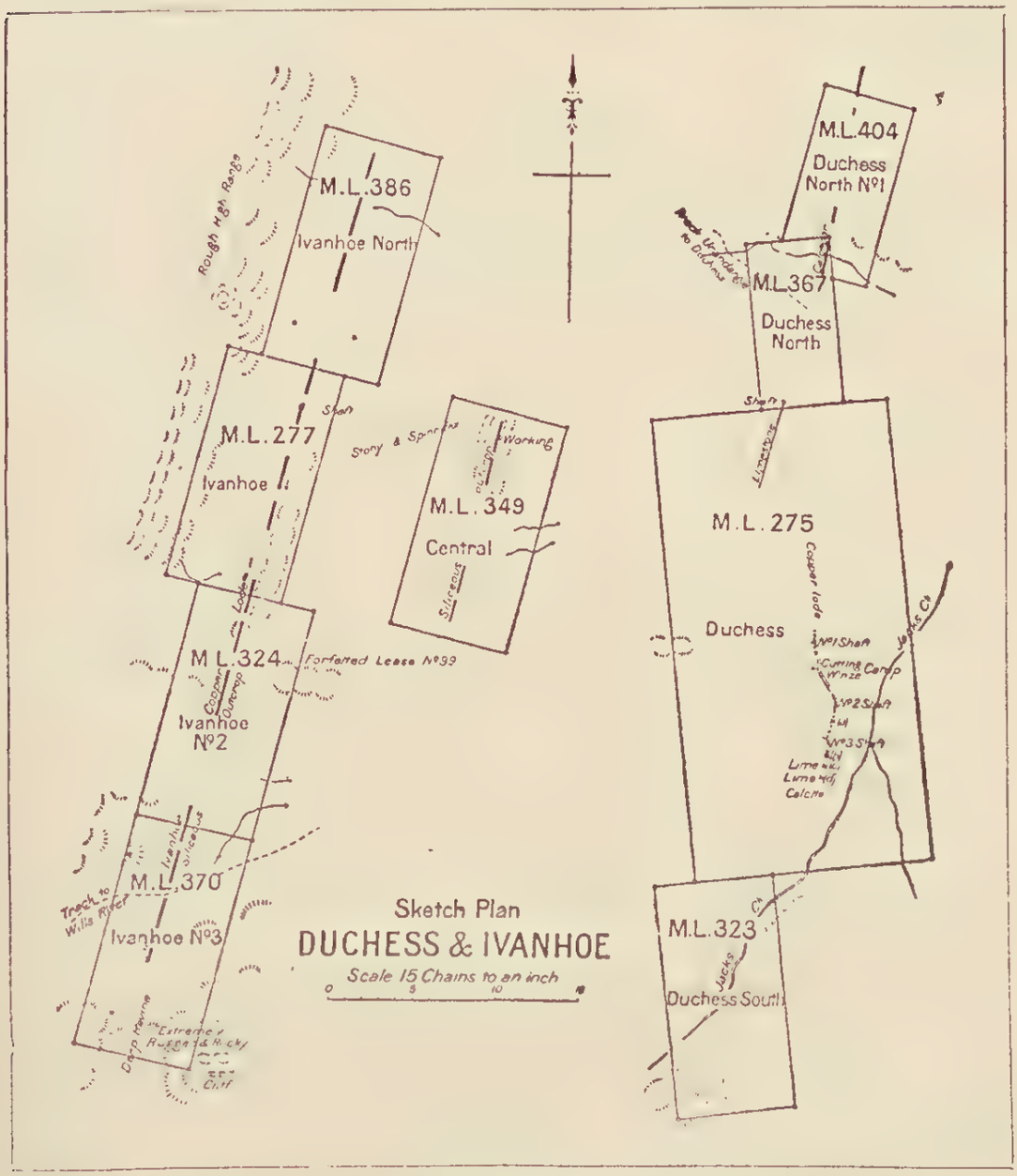
I consider this outcrop to be a series of shallow quartz veins impregnating the bedding of the sandstone and associated in places with rich copper glance. . . . I feel sure that very little work will prove it to be a surface aggregation.

Development.

The workings at the time of my visit were as follow:—

Four *trenches*: (a), 1 ch. south of No. 2 shaft; (b), ½ ch. south of No. 3 shaft; (c), 1 ch. south-south-west of No. 3 shaft; and (d) ¾ ch. beyond (c);

An *open cut* is, 2½ ch. long, 6 ft. wide and 12 ft. deep. The northern part is now being worked down in three benches.



A *winze*, 20 ft. deep, is near the centre of the open cut.

No. 1 shaft, the northernmost, is in about the centre of the lease a little over a chain north of the open cut. It is 55 ft. in total depth, and drives have been opened at the 45 ft. level for 40 ft. north and 60 ft. south. The drives were being extended when visited.

No. 2 shaft, 1 ch. south-south-east of the open cut, is 73 ft. deep. At 45 ft. depth a drive has been carried 15 ft. south and several feet north.

No. 3 shaft, 2½ ch. south-south-west of No. 2, is 52 ft. in total depth, and has drives at the 45 ft. level, 60 ft. to the south, and 66 ft. to the north.

OUTPUT.

1905—11$\frac{10}{20}$	tons shipped, containing	...	...	...	46% copper
1906—26$\frac{17}{20}$	,, ,,				
500	,, at grass ,,	...	...	...	35% ,,

GEOLOGY.

The country to the south of the workings is a pink indurated granular felspathic rock—probably once a sandstone—apparently striking north-east, though the evidence is not conclusive, it being difficult to distinguish between jointing and bedding planes, except where, as in the southernmost shaft, indistinct ripple marks are visible. In the other workings sandstone, slate, and schist alternately form the enclosing walls, and that alone points to the ore-body crossing the strata, but nevertheless there is not sufficient evidence to call this a fissure lode. It is more probably a succession of lenses on a crush zone. The dip of the ore-body is almost vertical, any underlie being to the west.

Water level is 50 ft. from the surface, and in No. 2 shaft water is making at the rate of 3,000 gall. per 24 hrs.

ORE-BODY.

It is understood that the ore originally rose several feet above the ground but the crop had been removed prior to my visit, when little could be learnt from an examination of the surface, beyond the open cut, of underlying ore-bodies.

The southernmost *trenches* (*c and d*) show nothing of the ore-body, though there is much sinter in the decomposed country and coarsely crystallised calcite crops just beyond.

In the *trench* (*b*), however, there is between 1 and 2 ft. of malachite and earthy cuprite ore.

In the *trench* (*a*) between shafts Nos. 2 and 3 is a formation 4 ft. wide, of which, however, only 6 in. is cupriferous.

In the southern part of the *open cut* the decomposed country adjacent to the ore carries much lime, and the ore-body (earthy malachite and glance) averages 3 ft. in width—4 ft. near the centre and 18 in. at the southern end—and contains 30% copper. To the south of the cut there is little ore cropping, and what there is is poor.

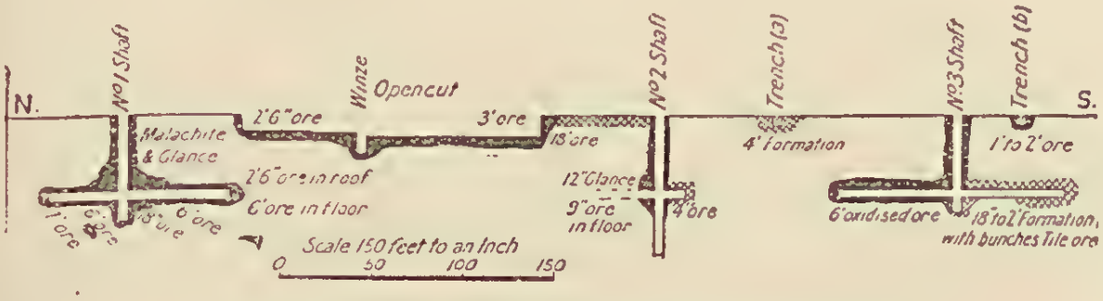
The ore bagged from the southern part of the cut, still at the mine, amounts to 150 tons.

In the face at the northern end of the open cut the ore-body (malachite, with some glance) increases in width from 18 in. at the surface to 2 ft. 6 in., 8 ft. below. The ore from the northern end of the cut, of which 100 tons is paddocked, is siliceous, containing lumps of quartz, but it will average 30% copper.

Besides this some 15 tons have been bagged, and there is over 100 tons of high grade ore in the tip. At the time of my inspection besides that bagged some 80 tons of unsorted ore, chiefly malachite and glance, lay at the cut.

The southernmost *shaft, No. 3,* has been sunk where the surface indications are not very favourable, and unfortunately no great improvement has taken place at a depth. In the southern drive on the 45 ft. level the eastern wall, dipping steeply to the west, is seen to be well slickensided. In the face the formation, only 18 in. to 2 ft. wide, consists of crushed country with quartz lenticules and bunches of tile ore stained with malachite, but nearer the shaft bunches of gossany tile ore are rather more abundant. The northern drive proved an average of 6 in. of oxidised ore (25% copper), but in the face there is 9 in. carbonate-bearing tile-ore which will probably average 30% copper, and in one place there is 2 ft. of formation, with lenticular bunches of ore and quartz. It is, however, not very well defined. The country rock is a felspathic sandstone proved for 26 ft. in the western crosscut; it has cleavages running north and south, but the bedding planes would appear from the indistinct ripple markings to be nearly north-east and south-west. The country rock east of the ore-body has a slaty appearance, but is really the same as the western. The work done in this shaft might be taken to indicate that the ore-body is on a true fissure, but on the whole it is more likely to be simply a shear zone along the master jointing.

Some ore has been bagged from here, but the seconds at grass are very siliceous.



SECTION ALONG LINE OF LODE, DUCHESS.

The *No. 2 shaft* workings reveal a somewhat more promising state of affairs. The ore is reported to be 2 ft. 6 in. wide at the shaft bottom, but the water is heavy. In the southern drive the formation, except in the face, where it pinches to 2 ft., is 4 ft. wide, but there is little copper ore in it. The country rock here is slate, the strike of which appears but indistinctly to be across the lode. In the roof of the northern drive 12 in. of rich glance ore is visible, and in the floor 9 in. The ore becomes very ferruginous in the face, but the presence of decomposing pyritic ore is indicated by abundant efflorescent epsomite. The ore-body is bounded on the east by 12 in. of quartz, the country rock being schist striking across the lode.

About 40 tons of ore lie bagged at this shaft, with 20 tons fine-grained siliceous seconds (15%) and 15 tons unsorted ore (20%)—the chief copper mineral being malachite, though much glance is also present.

No. 1 shaft shows malachite and metallic glance across its whole width at the surface and the exposures on the 45 ft. level are even better. At the shaft there is only 18 in. of ore, but a few feet north of it the body opens out to the full width of the drive, and in the face of the northern drive 7 ft. of ore is visible, while the western wall has not yet been reached. The ore is earthy malachite, with some earthy cuprite and a little dense limonite. It probably will average 35% copper, but is becoming less pure towards the west. In the southern drive the eastern wall has been considerably slickensided vertically, but the ore-body is very irregular. Halfway along the drive, where the country is schist, the ore is only 6 in. wide, and beyond it for some feet there is only poor formation; but it then gradually increases to 6 ft. Near the southern face a horse (of decomposed sandstone ?) comes in from above, and in the face the ore-body is only 2 ft. 6 in. wide in the roof, and, containing 20% silica, is much more siliceous than usual, but in the floor it is 6 ft. wide. Bunches of chalcocite, both dull and metallic (glance), occur in the oxidised ore and also in the quartzite here.

About 30 tons of ore lie bagged at this shaft, and 50 tons of firsts have been paddocked.

Ore Developed.

Owing to the extremely irregular nature of the ore-body, it is not possible in the present state of development to calculate with any pretence to accuracy the ore available above any level at the Duchess. From the data obtained in the drives on the Nos. 1, 2, and 3 shafts, a minimum of 5,000 tons may be depended on above the 45 ft. level without taking into account that the thick deposit of rich ore exposed in the open cut should also be struck by continuing the southern drive from the No. 1 shaft. Developmental work should be carried out vigorously, especially towards the north, in proving the ore at a depth and blocking it out to prove the value of the mine.

Duchess North (M.L. 367).

Location, Etc.

The Duchess North adjoins the Duchess on the north.

The area is 5 ac. The ground was deserted at the time of my visit.

A shaft has been sunk near the southern boundary to a depth of 35 ft.

Geology.

The shaft is in black micaceous schist, with bunches of calcite and bands of felspathic rock (altered sedimentary probably) just to the north of a crop of granular calcite a chain long and 6 ft. wide, changing southwards into yellowish limestone, with grains of quartz scattered through it. This limestone outcrop can be traced for 6 ch. to the south-south-west of the shaft in the direction of the general strike of the country, and it is therefore not the continuation of the Duchess lode. The latter has not been exposed within 10 ch. to the south, and in the intervening space may have been faulted or have pinched out altogether.

Duchess South (M.L. 323).

Location, Etc.

This adjoins M.L. 275 (Duchess) on the south-west.

Its area is 10 ac.

It was understood that no work had been carried out on this lease, and it was therefore not inspected.

Ivanhoe (M.L. 277).

Mgr., Peberdy.

Location, Etc.

The Ivanhoe lies ¼ mile west of the Duchess, on Burke River waters, 61 miles south-west of Cloncurry.

The area is 10 ac. This is the property of the Leichhardt-Cloncurry Development Syndicate.

Literature.

For titles of reports numbered as below see Introduction.

(4) Mr. Cameron wrote:

Lease No. 99 shows an outcrop of earthy ferruginous and cupriferous ore, associated with quartz, occurring along the bedding of altered sandstones and greywackes over a distance of about 70 yards, and over a breadth of perhaps 5 or 6 feet. Some portions look as if they might open up well, but no distinct outcrop of a lode can be observed.

(7) Mr. Rutherford states:

"The copper staining is confined to patches of limestone and to some prominent boulders of jasper. The property seems to me of little promise."

(12) Mr. Waller considers the Ivanhoe a lode, and says that—

"Concentration of copper ore may be reasonably expected underneath the capping at and below the permanent water level. The prospects of discovering rich deposits are greatly strengthened by the success which has been attained at the Duchess Mine."

Development.

At the time of my visit only a few potholes had been sunk, but preparations were being carried out to begin the sinking of a deep shaft near the northern end of the lease.

Geology.

There is here a pronounced crop, 12 ft. in greatest width and 4 ch. in length, of silicified limonite, in which can be seen some pure quartz and occasional bunches of poor copper ore. The latter consists of carbonates and reddish oxides (20% copper), and the largest bunch seen contained only a ton or two at most. The crop has a considerable extension, but owing to the limited time available and the absence of workings, the necessity to traverse much of it was not apparent. The crop agrees with the strike of the country, and in all probability represents a bed of impure limestone in which the calcium carbonate has been replaced by iron oxides and silica, and as such it is not expected to prove a great copper producer.

Wild McGregor (M.L. 481).

Location, Etc.

The Wild MacGregor is 25 ch. south of the Duchess, which is 61 miles south-west of Cloncurry. The road to Devoncourt and Cloncurry crosses this lease.

The area is 10 ac.

The main shaft is 30 ft. deep, and there are besides several other insignificant openings.

Geology.

There is no defined outcrop here, the ore presumably occurring as bunches in decomposed slate. The ore bagged amounts to 5 tons.

Maude A. (M.L. 360).

Mgr., Alexander.

Location, Etc.

The lease is 1½ mile south-south-east of the Duchess South, and 3 ch. north of the Burke Rabbit Board's fence.

The area is 3 ac. This lease was not inspected.

A shaft and a cut are shown on the surveyor's plan.

Output.

1906—7$\frac{10}{20}$ tons shipped.

Ore-body.

The crop is shown on the surveyor's plan striking east-south-east.

Revenue (M.L. 379).

Location, Etc.

The Revenue is 5 miles north-north-west of the Duchess North No. 1.

The area is 5 ac. This lease was not inspected.

The surveyor's plan shows two shafts and other workings.

Ore-body.

The strike of the ore-body according to the surveyor's plan is north by west.

PILGRIM GROUP.

This group was not visited, as it was understood that no work was going on.

Pilgrim (M.L. 276).

Mgr., Kennedy.

Location and Area.

The Pilgrim is 3 miles south-west of the Duchess.

The area is 10 ac. This is part of forfeited leases Nos. 55 and 98.

Literature.

For titles of reports numbered as below see Introduction.

(4) Mr. Cameron's full report is as follows:—

Lease No. 98.—Indications of copper are found on this lease along a belt of limestone running north and south through the lease along its western boundary. The limestone belt, which has narrow bands of interbedded schists, is from 60 feet to 100 feet in breadth. It is coarse-grained, and has a distinct schistose structure, the calcite grains lying with their shorter axis at right angles to the stratification. Along this belt of limestone occur several prominent outcrops of a siliceous rock similar to that found in the Cloncurry and Hampden Lodes. They are as much as 10 to 20 feet across and up to 20 feet in height. They are not apparently ore-bearing. On the south-western side of the southernmost of these, however, a little glance and carbonate ore is exposed; but it is almost entirely covered with soil, and its extent cannot even be guessed at. About 20 chains from the north end of the lease on the line of the siliceous outcrops is an outcrop of copper ore—glance and carbonate—apparently about 20 feet through. A sample from here assayed 27·1 per cent. of copper, a trace of gold, and 6 oz. 15 dwt. 22 gr. of silver per ton. This outcrop is well worth systematic prospecting. Its continuation is obscured by surface accumulations and it is possibly rich for some distance further north.

Lease No. 55.—The copper indications on this lease occur in a steeply-inclined bed of limestone some 30 feet in width, and outcropping for a distance of about 70 yards, in places to a height of 10 feet above the ground. The copper occurs as little blebs of carbonate scattered throughout the limestone. A sample taken from across the most likely-looking portion of the outcrop gave 3·8 per cent. of copper. This is, if anything, probably a little higher than the average, as in chipping off pieces for a bulk assay it is difficult to avoid turning one's attention more particularly to points where ore occurs.

Further to the south the limestone has apparently been replaced by quartz in a line continuous with its outcrop. The quartz can be traced for about 30 feet, and is copper-bearing for about 3 feet in width. The ore is glance and tile ore, and two assays of ore picked from the surface gave 14·5 per cent. of copper and 26·125 per cent. of copper respectively. This lode shows every appearance of being worth opening up over this latter portion.

Mr. Rutherford speaks of:

A siliceous limestone belt which is impregnated with copper carbonate, the result of decomposition of glance, which occurs in pisolitic form in the rock. Beyond the limestone to the south are contorted hills of weathered sandstone showing bedding places and stained with copper in places. It was probably from this overlying rock that the copper in the limestone was derived.

Pilgrim Extended (M.L. 485).

Mgr., Kennedy.

Location, Etc.

This adjoins the Pilgrim.

Its area is 30 ac.

Empress (M.L. 610).

Mgr., Need.

Location, Etc.

The Empress is understood to adjoin the Pilgrim.

Its area is 10 ac.

TRIKELANA GROUP.

Very little had been heard of the Trikelana at the time of my visit to the southern part of the field, and the group was therefore missed—unfortunately, to judge by latest accounts.

Trikelana (M.L. No. 522).

Location and Area.

The Trikelana lies on Pilgrim Creek waters, 9 miles south of the Duchess, which is 61 miles south-west of Cloncurry.

The area is 10 ac. This lease was not inspected.

Development.

A shaft had been sunk 39 ft. in Oct., 1906. It is understood that an open cut, 87 ft. long, 10 ft. wide and 6 ft. deep, has now been opened.

Output.

1906 ... 6 tons shipped.

It is reported that the open cut produced:

30 tons of ... ... 25 % ore, and
100 ,, ... 16 % ore.

Ore-body.

The deposit made little or no outcrop at the surface, its presence being indicated by floaters of ore. Two specimens from the mine were given me by Mr. Allis, the owner. One contains much free quartz and kaolin, and is evidently from near the surface, being formed in great part of limonite, with stains and veins of malachite and chrysocolla—contents 10% copper. The other shows chalcopyrite in process of alteration into limonite and glance, and stained externally to some extent by malachite; this is representative of the 25% ore.

Inheritance (M.L. 657).

Mgr., Allis.

Location, Etc.

The Inheritance is located north-east of the Trikelana.

Its area is 20 ac.

Legacy (M.L. 658).

Mgr., Allis.

Location, Etc.

The Legacy lies north-west of the Trikelana.

Its area is 10 ac.

MOUNT BIRNIE GROUP.

The group lies 74½ miles south-south-west of Cloncurry. It was not visited as practically nothing had been heard of it at the end of last year.

Mount Birnie (M.L. 686, Etc.).

Mgr., McLeod.

The Mount Birnie leases lie within ½ mile to the west of Mount Birnie itself. They are connected by road both with Cloncurry and with Boulia.

Area.

Mineral leases Nos. 686, 742 (No. 2), 743 (No. 3), and 744 (No. 4), are each 10 ac. in area. Three other 10 ac. leases, and one of 15 ac. have been taken up round these.

Development.

Mr. McLeod has shown me a plan of the workings, complete to June, 1907. This shows, on M.L. 686, a trench 20 ft. long and 10 ft. deep, and four shafts—No. 1, 50 ft. deep, with a 15-ft. crosscut to the east at 45 ft. depth; No. 2, 15 ft. deep; No. 3, 10 ft. deep; and No. 4, 6 ft. deep. On the lease to the west two shallow shafts have been sunk; on that to the south-east is another; and on the eastermost lease is another.

Ore-bodies.

The main ore-body on M.L. 686 is believed to strike north by east. The trench on it is understood to be wholly in ore-bearing country, there being a cupriferous and ferruginous blow to the north, 15 ft. wide, rich in cuprite over a width of 4 ft. The main shaft on the western side of the blow was sunk to water level (about 65 ft. below the surface). Numerous assays, showing high copper content, have been made of material from the shaft, but most of the specimens were probably taken from rich seams of ore. No. 2 shaft on the main line of strike has also yielded rich stone, including dense glance stained by malachite. At least six other outcrops, running in various directions, have been located on the leases.

Monastery (M.L. 467).

Location and Area.

The Monastery lies 5 miles west of the Mount Birnie and 18 miles south of the Duchess, which is 61 miles south-west of Cloncurry.

The area is 10 ac. This lease was not visited.

Development.

Open cuts are said to be almost continuous over a length of 150 ft., the most northerly being 9 ft. long, 4 ft. wide, and 12 ft. deep.

Output.

1906	...	...	6 tons shipped.
	...	...	6 ,, ,, containing 30% copper.

Ore.

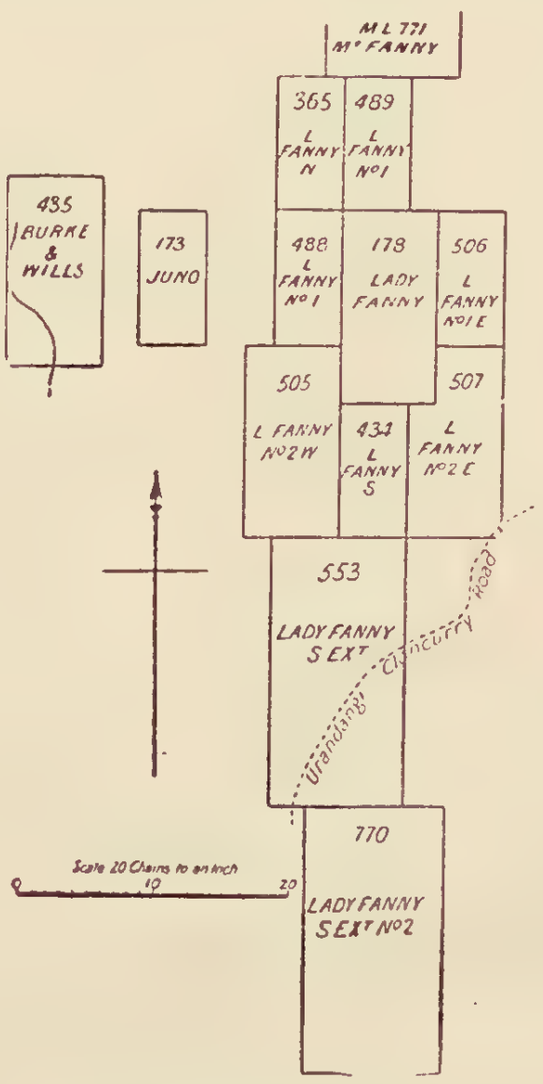
The ore is glance and malachite uniformly high in grade, and it was reported that 50 tons of 20% ore were paddocked early in the year.

WILLS RIVER.

The Mount Hope Group is included under this heading, because of the usual practice, but the mines are really within the Burke River catchment area.

LADY FANNY GROUP.

The Lady Fanny group, which is 60 miles south-west of Cloncurry, comprises, besides a number of leases adjacent to the original, the Italian, Prodigal, Blue Spec, Chum Victoria, Burke and Wills, etc.



LADY FANNY GROUP

The Lady Fanny porphyries are similar to, but in much greater bulk than, those at the Dobbyn-Boundary Group. The association of copper ores, especially chalcocite, and porphyries is to be noted in connection with the discoveries at Ely, Nev., where immense bodies of ore containing 2 to 2½% copper are to be worked in the near future.

Lady Fanny (M.L. 178).

Location.

The Lady Fanny is located near the head of a small tributary of the Wills River a quarter of a mile west of the main Urandangi road at a point 60 miles south-west of Cloncurry, and 4½ miles north-east of Teddington Lock station, on the Wills River. The distance by road from Cloncurry, taking the New Bridgewater short cut, is 77 miles.

Area.

The area is 10 ac.

It is reported that a Melbourne syndicate had secured a 6 months' option in January last, but at the time of my inspection there was no one on the ground.

Development.

The workings comprise three trenches; one shallow hole, and two shafts.

Two of the trenches are on the southern end of the main outcrop, the third on a separate crop two chains to the west. The shallow hole is on the eastern side of the main outcrop.

The old gold shaft was sunk in 1900, and is reported to be 60 ft. deep.

The new shaft, 50 ft. west of the main crop, is 103 ft. deep. It was inaccessible to me, but it is known that at the 100 ft. level there are crosscuts east and west, their total length being 100 ft.

Output.

1905	...	10 tons.
1906	...	20$\frac{13}{20}$ tons shipped, containing 27% copper.

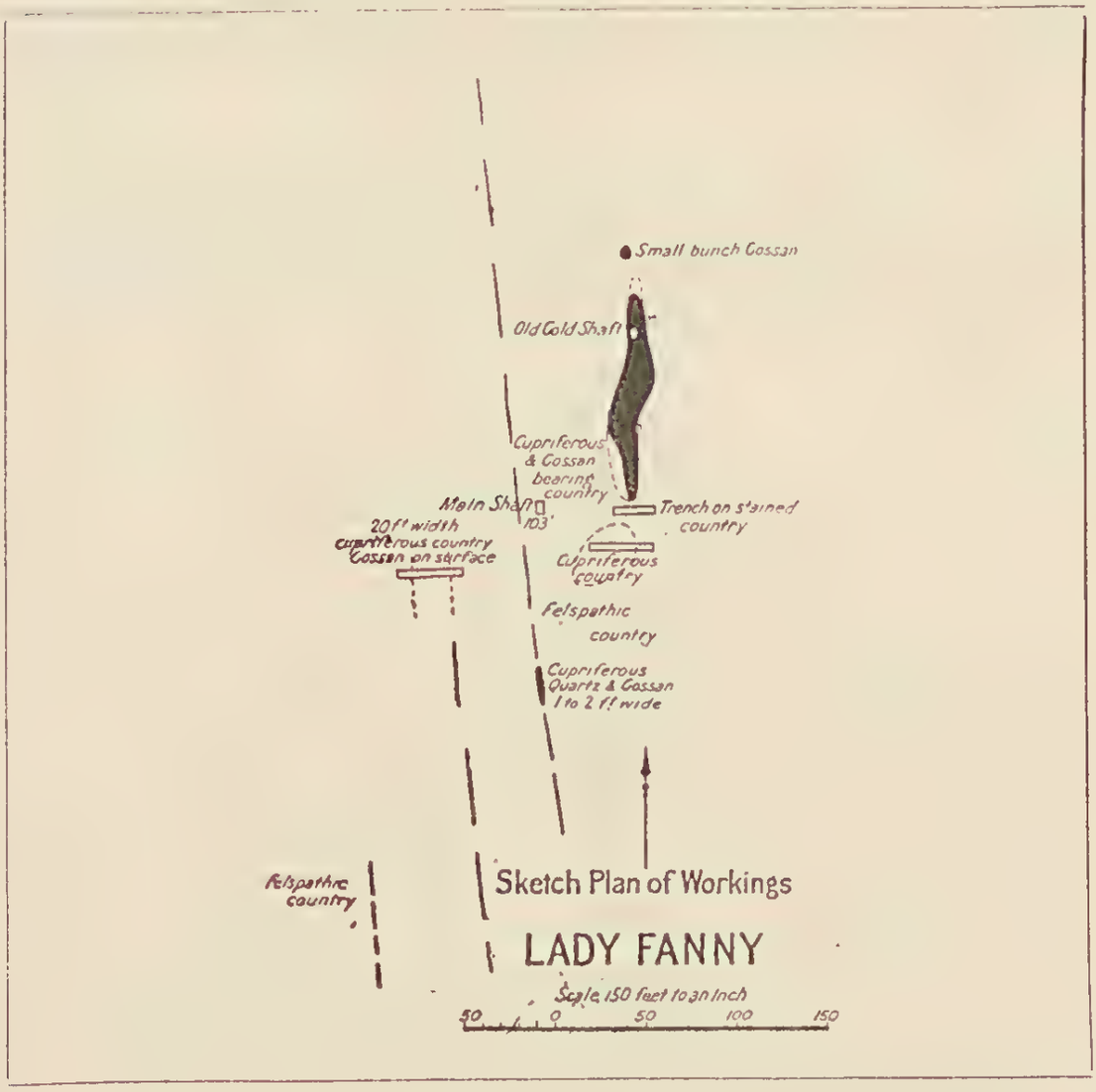
Geology.

This is an area of schistose slate and porphyry in alternate belts. The slates, over wide areas, have been rendered cupriferous, the copper minerals occurring as impregnations veins and bunches. A feature of the separate bunches on the northern part is that their general run is slightly east of north, while the cupriferous belt, as a whole, strikes slightly west of north. Only one body of any considerable size reaches the surface, and the limits of that have not been tested. The cupriferous belts are well worthy of prospecting by crosscutting, preferably from underlie shafts in the more gossany outcrops.

Ore-bodies.

The main crop stands 10 ft. above the general level of the ground, averages 10 ft. in width (the central part is 15 ft. wide), and is 2 ch. in length. It consists of gossan, most of it carrying malachite and tile ore and some gold; that at the southern end however is cellular and, as to be expected, then carries no copper, it having been leached downwards. The body tapers out northwards, and, beyond the one small patch of gossan 5 ft. in diameter, makes no further show on the

surface. It ends more abruptly on the south, the trench there exposing only slightly stained country. Just beyond this, however, the country over a width of 30 ft. is veined with green carbonate, and carries bunches of gossan, but there is no further sign of a massive ore body. The gossan would therefore seem to be the outcrop of a big bunch or shoot.

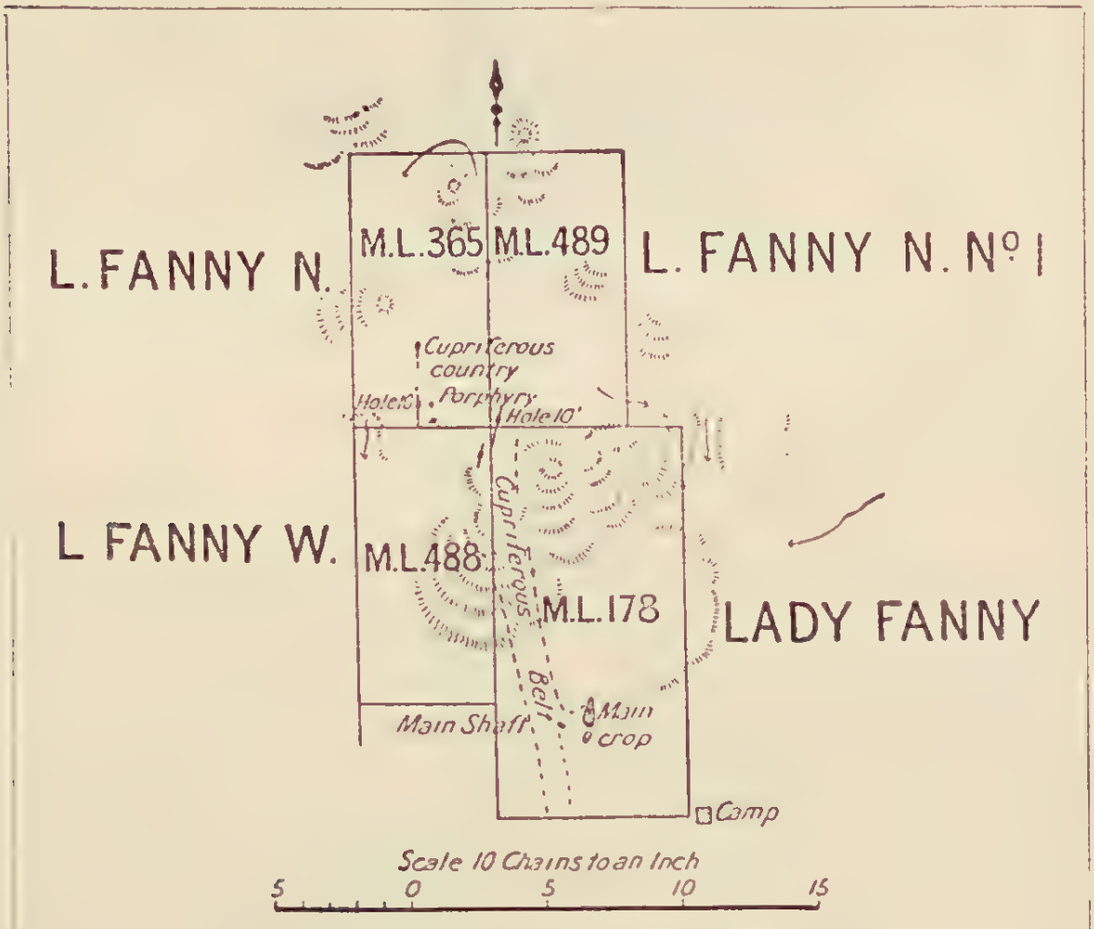


The hole sunk on the eastern side shows the ore to be not well defined from the kaolinised country to the east, into which irregular bunches project. About 17 tons of ore, assaying 27·75% copper, have been shipped from this hole. The 10 tons of ore at grass, consisting of gossan with malachite and tile ore, will probably run 20% copper.

The old shaft was sunk for gold, specks of which could be seen in the ore, but the highest yield reported was only 13 dwt. per ton. The material of the tip comprises soft gossan. This shows no copper, but copper will most certainly be found beneath it, and the shaft should therefore be deepened.

The main shaft, sunk to test the ore at a depth, instead of being in the ore-body—underlying if necessary—is in the hanging-wall country to the south-west. Very encouraging reports appeared while the work of sinking and cross cutting was in progress; sulphides were

first met at 65 ft. depth, and at the shaft bottom the body was said to be 12 ft. wide and to assay, with that in the shaft, 25% copper; but there is no evidence of any quantity of ore having been raised from the shaft. The rock on the tip is bluish chloritic schistose slate, in which chalcopyrite occasionally occurs disseminated and more often as veins. Interesting changes have taken place in the country rock where it has become impregnated with chalcopyrite, the chief of which has been the production of crystalline hornblende. This occurrence is perhaps analagous to that at Rossland, B.C.,* where the deposits are considered to have been formed under dynamic metamorphic conditions. The amount of cupriferous country visible is only a few tons, but there may be more buried in the tip. The surface indications—the trench shows only stained country—are not favourable for success in cross cutting at this particular spot, but veins of chalcopyrite do seem to have been cut, and now these might be followed to the north to strike the main ore-body.



PART OF LADY FANNY CUPRIFEROUS BELT.

Just to the west of the main shaft is a belt of copper-bearing country, 2 ch. in width, which can be traced over a distance of 10 ch. A trench on the belt 1 ch. south-west of the main shaft exposes a width of 20 ft. of copper-bearing country seamed with gossan, and,

*Metasomatic Processes in Fissure Veins. By Waldemar Lindgren. Am. Inst. M., Eng., Washington, 1900.

4 ch. south of the main shaft, there is a crop of quartz and gossan probably 2 ft. wide, on which, however, no work has been done. The southern part of the belt is well worth a thorough prospecting; but, in the north western corner of the lease, conditions for the development of large bodies do not appear to have been so favourable, the ore bunches being comparatively small and the intervening country exceedingly hard and undecomposed. Though a few tons may be got from the surface, this part of the belt is not likely to be ever mined as a whole.

Lady Fanny North (M.L. 365).

Location and Area.

This lease lies north-west of the Lady Fanny, adjoining it only at the south-eastern corner.

The area is 5 ac. The lease was unmanned when seen by me.

Development.

The workings, which are at the southern end of the lease, 90 ft. above the Lady Fanny brace, comprise two potholes 2 ch. apart, one of which, the southern, is 10 ft. square and 10 ft. deep.

Output.

4	tons shipped containing	... ...	20% to 30% copper.
1906 5½	,,		

Ore-bodies.

At the northern hole only copper-bearing country rock is visible, but at the southern hole can be seen 9 in. of gossany material on the west and 18 in. of similar stuff on the east of 8 ft. of kaolinised porphyry. The ore can be traced on the surface for ½ ch. north of the big hole and 1 ch. south, where there is 3 ft. width of gossany country and quartz containing say 10% copper.

The seconds at grass, about 5 tons weight, consist of blue and green carbonate in siliceous gossan, and contain 10% copper.

Geology.

These bodies probably simply fill cracks of limited extent. The country is hard schistose porphyry, and though the separate bodies give no sign of permanance the possibility of the porphyries being uniformly cupriferous at a depth is not to be overlooked.

Lady Fanny North No. 1 (M.L. 489).

Location, Etc.

This adjoins the Lady Fanny on the north.

The area is 5 ac. The mine was idle when inspected in January.

Only one hole, 10 ft., has been opened, and that is in the south-western corner.

Ore-body.

The ore-body can be traced southwards for nearly a chain into the Lady Fanny. In the hole it is 2 ft. 6 in. wide—the usual oxidised

gossany ore, rather siliceous but containing at least 20% copper. The felspathic country rock is much kaolinised, and, as in the Lady Fanny North, may prove evenly cupriferous at a depth.

Unnamed (M.C.).

Location, Etc.

This lies 1 m. north of the Lady Fanny. It was not visited by me.

There is a 10-ft. open cut (May, 1907).

Ore-bodies.

There is reported to be a formation, 1 to 2 ft. wide, of copper ore (oxidising pyrite) and crystalline hæmatite. Gold occurs in paint and sheet form on the faces of the crystals of hæmatite, having probably been leached from the adjacent copper ore and reprecipitated there.

Lady Fanny West (M.L. 488).

Location, Etc.

This adjoins the Lady Fanny on the west.

The area is 5 ac. The lease was idle at time of visit in January of this year.

The only opening is in the north-eastern corner of the lease; it is 10 ft. deep.

Ore-body.

The hole is on a body 9 to 18 in. wide of malachite-bearing tile ore in felspathic country, kaolinised near the lode. The ore cuts out a few feet south of the hole, but shows for half a chain to the north-east, in which direction it becomes very siliceous. No large amount of ore is likely to be found here.

Juno (M.L. 773).

Location.

The Juno is 10 ch. west of the Lady Fanny.

Its area is 5 ac. Not visited.

Burke and Wills (M.L. 435).

Kennedy.

Location.

The Burke and Wills lies 18 ch. west of the Lady Fanny.

Its area is 10 ac. Not visited

Italian (M.L. 689).

Location, Etc.

The Italian lies just west of the main Urandangi road, one mile south-south-west of the Lady Fanny.

The area is 5 ac. The mine was deserted when inspected, and had been idle for months.

Development.

The workings, all within a very small area, comprise an open cut and four shafts, sunk early in 1906. The open cut is 20 ft. long, 6 ft. wide, and 12 ft. deep. An underlie shaft, sunk in the middle of the

cut, is 15 ft. deep. A vertical shaft, 10 ft. to the east of the shaft in the cut, is 15 ft. deep, and the other, 10 ft. to the south of it, is 46 ft. deep (inaccessible). The fourth shaft, which is shallow, lies 10 ft. east of the second.

Output.

1906 ... ... $37\frac{15}{20}$ tons shipped.

Ore-body.

The formation in the open cut averages 5 to 6 ft. in width. It consists of calcareous kaolinised rock stained with malachite throughout and containing bunches of gossan, with veins of acicular malachite and patches of tile ore. The ore-body was reported to be 3 ft. wide in the cut and 18 in. wide in the central shaft. The body probably does not extend beyond the limits of the open cut, but the alluvium of the flat precludes certainty on that point.

The firsts (30% copper) at grass amount to 2 tons, and consist of quartz-bearing limonite, with chalcopyrite altering into glance and veined by radiating malachite. The seconds, about 10 tons, consist of gossan with malachite, and probably will run 15% copper.

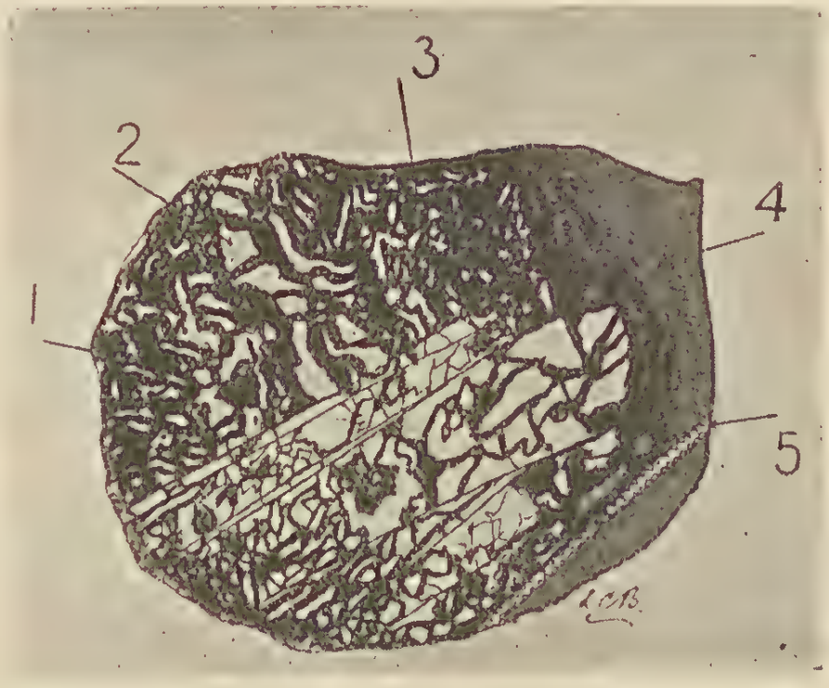


Fig. 2 (double natural size).—Chalcopyrite altering into chalcocite and limonite, Italian.

1. Chalcocite.
2. Unaltered chalcopyrite.
3. Chalcocite, with a little unaltered chalcopyrite.
4. Limonite, with very little chalcocite.
5. Malachite (vein).

The country rock, where visible north, south, and west, is porphyry, but to the east there is schist.

The southern shaft is in softened chloritic schist, and some glance and earthy secondary sulphide ore containing native copper has been raised from it.

Blue Spec (M.L. 368).

Gairns.

LOCATION, ETC.

The Blue Spec is 1¼ mile south-south-east of the Italian.

Its area is 5 ac. Not visited.

ORE-BODY.

The survey plan shows an outcrop striking north-west and south-east.

Blue Light (M.L. 703).

LOCATION, ETC.

The Blue Light is ½ mile north of Blue Spec

Its area is 5 ac. Not visited.

Lady Don (M.L. 702).

LOCATION, ETC.

The Lady Don is ¼ m. west of Blue Spec.

Its area is 10 ac. Not visited.

Prodigal (M.L. 490).

Mgr., Riordan.

LOCATION, ETC.

The Prodigal lies 2½ miles south-south-east of the Lady Fanny.

The area is 5 ac.

There is one shaft 35 ft. deep, and an open cut running 12 ft. south of the shaft.

OUTPUT.

1906—16 tons shipped, containing ... ... 23% copper.

ORE-BODIES.

The ore here forms a very irregular body between porphyry, which, near the lode, has been rendered micaceous, and quartzite cropping to the north. The gossan cap, very siliceous in places, can be followed for 1 ch., to the north-west (beyond which there are occasional trace of copper for 2 ch.) and for 1 ch. to the north-north-east (the indications beyond being to the east-north-east).

The formation in the shaft varies between 1 ft. and 6 ft. in thickness. It has not defined walls, but dips 1 in 3 to the south. The ore masses are very irregular in form, and half way down the shaft almost disappear, but in the bottom ore is exposed over a width of 4 ft.

The ore at grass (10 tons bagged and 9 tons broken) is dense limonite with grains of quartz (silica at least 25%) and disseminations and veins of malachite and tile ore; but, though glance is reported to be found occasionally, none was seen. This should yield 25% copper.

Chum Victoria (M.L. 690).

LOCATION, ETC.

This lease is about 1 m. north of the Lady Fanny.

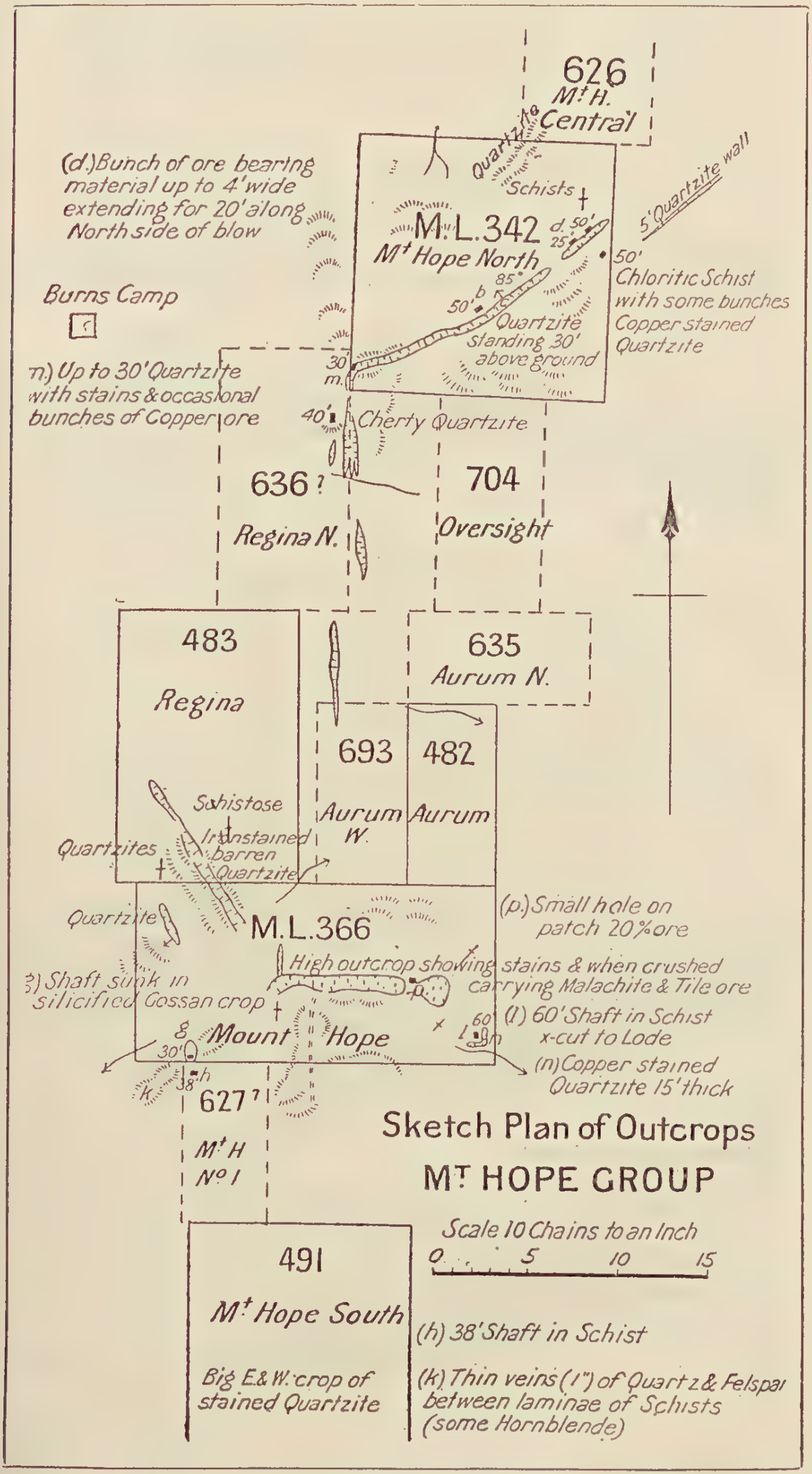
The area is 20 ac. The lease is under option to the Mount Hope Co. (May, 1907). It was not inspected by me.

ORE-BODIES.

There are reported to be here similar occurrences to those at the Lady Fanny and to be opening up well (May, 1907).

MOUNT HOPE GROUPS.

The group proper, 53½ miles south-west of Cloncurry, comprises only the Mount Hope, Regina, Aurum, and numbers, but the Little Beauty and others in the vicinity are included here for convenience.



The immense quartz blows of Mount Hope are not quite duplicated in any other part of the field, and the locality is also distinguished by the presence of aplite dykes or veins, evidence of expiring deep-seated igneous activities.

Mount Hope (M.L. 366).

Mgr., Pasley.

LOCATION, ETC.

Mount Hope is located on one of the head branches of Green's Creek, a tributary of the Burke River, 53½ miles south-west of Cloncurry.

The area is 20 ac. This lease was deserted when inspected.

DEVELOPMENT.

The workings comprise two inaccessible shafts and a pothole. One of the shafts, 30 ft. deep, is on the southern boundary near the south-western corner of the lease; the other, 60 ft. deep, is in the south-eastern corner, and from it a crosscut runs south. The state of the workings did not allow of my making an underground inspection.

OUTPUT.

1906 ... ... $10\frac{15}{20}$ tons shipped.

ORE-BODIES.

Very little copper ore can be seen at the surface in this lease, but there are five prominent quartz and quartzite outcrops.

One, quite barren, in the north-western corner, is three chains long and several feet wide. It strikes north-west, dipping to the south-west across country striking north and south.

The second crop, 4 ch. to the east, is a prominent wall of barren quartzite, 10 ch. in total length, coming in from the north-west.

The third is a narrow but well marked body of quartz, 2½ ch. long, striking north and south with the country.

The fourth and main outcrop, into which the last merges, strikes east and west through the north and south striking country. It is 10 ch. in length, averages 15 ft. in width, and stands 10 ft. above the general level of the ridge. At the eastern end it bulges out to over 30 ft. in width. The silica has metasomatically replaced the country rock, and deposition has taken place since the production of north and south schistosity, which can be distinguished in places in the quartzite. Malachite and cuprite occur in the more crushed parts, but distinctly most abundantly where certain strata abut against it. The ore is seldom richer than 10%, and there is no large quantity even as rich as that. The crop, as a whole, is richer at the eastern wider end, on the northern side of which a shallow hole has been excavated on a small patch of 20% ore, consisting of malachite, cuprite, and limonite, in quartzite.

The fifth is a bow-shaped crop of copper-stained quartzite, 15 ft. thick. The 60 ft. shaft, just to the north, was sunk to test the body

at a depth. The rock on the tip is dark chloritic schist, some of it stained by copper carbonate, but though good ore was said to have been obtained, little can be seen on the surface. The strike of the country is here north-east.

Another more promising crop of silicified gossan, 40 ft. in length and 15 ft. wide, is to be seen in the south-western corner of the lease, where the 30 ft. shaft has been sunk. The ore from the shaft bottom —dense gossan with carbonate stains—is not unpromising, but the greater part of the sinking was in very siliceous ore, and much of the tip is ironstained quartzite. About 15 tons of 5% ore have been paddocked.

Geology.

The occurrence of pegmatite—quartz and orthoclase (exhibiting a strong parting and a slight schiller structure), with occasional hornblende—as thin veins between the laminæ of the schists at the south-western corner of the lease, as well as over much of the country to the north-east, is interesting and important in considering the genesis of the quartz bodies. Pegmatites are the after result of igneous intrusion, the minerals having been given off pneumatolitically from the cooling magma, and it has been shown* in other parts of the world that pegmatites shade insensibly into quartz veins carrying copper minerals. It is therefore extremely probable that the Mount Hope quartzites are of deep seated origin.

Mount Hope North (M.L. 342).

Location, Etc.

The lease is situated ½ mile north of the Mount Hope lease.

The area is 20 ac. This ground was deserted in January, but Mr. Burns, manager of the adjoining lease, conducted me over it.

Development.

The prospecting of this lease was done during 1905 and 1906 by the Hampden Company, who, when holding an option over the property, sank 5 shafts. No. 1 shaft, in the south-western corner, is 30 ft. deep; No. 2 shaft, 8 ch. to the north-east, is 50 ft. deep; No. 3 shaft, 6½ ch. north-east of No. 2, is 25 ft. deep; No. 4 shaft, 1 ch. beyond No. 3, is 50 ft. deep; and No. 5 shaft, 1½ ch. south-east of No. 4 and adjacent to the eastern boundary, is 50 ft. deep, and has drives 50 ft. to the south and 50 ft. to the north.

Output. (Warden's reports.)

Dec., '05	20 tons raised	40% copper
Mar., '06	40 ,, ...	?
May, '06	5 ,, bagged.	

Ore-body.

The outcrop tested by four of the above shafts strikes north-east-by-east across the lease from the south-western corner, where it makes

* The Rôle of the Igneous Rocks in the Formation of Veins. By J. F. Kemp. Am.Inst. Min. Eng., Richmond meeting, Feb., '01.

a sharp bend and runs south. It consists of dense white quartzite up to 30 ft. thick, and standing in places 30 ft. above the ground. The quartzite carries only traces of copper, the stains being mostly on the surface.

In shaft No. 1, on the western side of the crop, no ore was found, though a few yards to the south the quartzite carries stains and occasional bunches of ferruginous ore over a width of 30 ft.

Shaft No. 2 is on the hanging-wall side of the quartzite, and nothing more than stains of malachite in ferruginous quartzite was found.

At shaft No. 3 a bunch of ore-bearing material, up to 4 ft. wide, extends along the northern face of the quartzite for 30 ft., but only ironstained quartzite seems to have been raised. These workings have thus proved nothing of value, and there is no surface indication of any quantity of copper ore here.

FIG. 3 (DOUBLE NATURAL SIZE).—CUPRITE-BEARING ORE, MOUNT HOPE, NORTH.

1. *Chalcedonic silica.*
2. *Cavity.*
3. *Malachite stained silica.*
4. *Cuprite.*
5. *Mammilated hyaline silica.*

No. 5 shaft was sunk to prove a parallel crop of quartzite to the south-east of the main one. The rock on the tip is chloritic schist, with some bunches of copper-stained quartzite and a little chalcedonic quartz, distributed through which cuprite occurs irregularly scattered, surrounded by a staining of malachite. It is understood that 12 tons of 23% ore was despatched from here. This is the only place on the ground from which any shipping ore has been obtained.

Regina North (M.L. 636).

Mgr., Burns.

Location, Etc.

This lease adjoins Mount Hope North at the south-western corner.

The area is 10 ac. This lease had not been surveyed when inspected. It is the property of a Melbourne syndicate.

Development.

The only work in progress was the sinking of a shaft 50 ft. west of the Mount Hope quartzite crop in the north-eastern corner of the lease. It was then 40 ft. deep. The sinking of this shaft and that on the Mount Hope No. 1 was the only work then going on in the Mount Hope Group.

Ore-body.

The Mount Hope North quartzite bends and runs south in this lease. At the south-western corner of the northern lease it is slightly cupriferous, but in this is quite barren. The crop, which is rather cherty in parts, frays out about 5 ch. south of the Mount Hope North, but several other isolated crops appear on the line of strike to the south. The shaft is being sunk 50 ft. distant to the west of the crop, to catch the quartzite on the underlie, but at 40 ft. depth was still in schist. There appears to be no justification for sinking here.

Regina (M.L. 483).

Mgr., Burns.

Location, Etc.

It adjoins Mount Hope on the north, at the western end.

Its area is 15 ac.

There are no workings.

Ore-body.

A large body of barren iron-stained quartzite enters the lease at the southern end. Its strike is north-west, while that of the country is definitely north and south.

Aurum (M.L. 482).

LOCATION, ETC.

It adjoins Mount Hope on the north, at the eastern end.

Its area is 5 ac.

No work has been done.

ORE-BODIES.

None. The country is silicified slate.

Mount Hope No. 1 (M.L. 627).

LOCATION, ETC.

This adjoins Mount Hope on the south.

The area is 5 ac.

One shaft near the northern boundary 38 ft. deep, in process of sinking in January, 1907.

ORE-BODY.

There is no crop here, the shaft being sunk in search of that cropping in the south-western corner of the Mount Hope, but there is no justification for the work.

Mount Hope South (M.L. 491).

LOCATION, ETC.

This lease is 10 ch. south of the Mount Hope.

The area is 30 ac. The lease, being deserted, was not inspected.

There are no workings.

ORE-BODY.

A large crop of copper-stained quartzite, of the character of the others in the Mount Hope group, is visible from the road.

Monarch Senior (M.C. 352).

LOCATION, ETC.

The Monarch Senior is about 3 miles east of Mount Hope and ¼ mile south-by-west from the Blue Jacket, on Spring Creek waters.

Four men's ground, 400 ft. × 350 ft. Deserted.

DEVELOPMENT.

The southern shaft is 50 ft. deep; 1 ch. to the north-east is a pit 6 ft. deep; 50 ft. to the north-north-west of the pit there is a shaft 30 ft. deep; just to the north of the last is a pothole; and a chain beyond there are two others.

OUTPUT.

1905	...	...	5 tons shipped, containing 28% copper.

Ore-bodies.

At the southern end there is little outcrop, but at the northern end 18 in. calcite can be seen, and beyond the northern potholes cupriferous limonite boulders are scattered over the surface for a distance of a chain.

The southern shaft being ladderless, a descent could not be made. The country is black chloritic schist, in which the ore probably occurs in bunches. The firsts at grass, 5 tons, consist of chalcopyrite, with infilled chalcocite, free from quartz and likely to yield 40% copper. The seconds, amounting to 5 tons, consist chiefly of limonite with veinings and infillings of carbonates and traces of silicate, and will run 15% copper. The tip, as a whole, may be expected to carry 5% copper. A specimen of pyrite, said to have come from the bottom of the shaft, was shown me. It bore signs of having suffered leaching, and was said to have been directly overlain by glance and covellite (?).

The pit to the north-east presumably was opened on a bunch, for schists only are now visible in the hole. There is about 1 ton of 10% ore at grass.

At the central shaft about 10 tons of 20% ore lies at grass. This is gossany limonite, with stains and impregnations of malachite, some tile ore, and a fair quantity of chalcopyrite, as usual partly converted into chalcocite and limonite and tesselated in appearance.

In the northern potholes only boulders of cupriferous limonite were found.

There is thus no evidence of any large quantity of ore on this claim, but it must be remembered that most of the surface is covered by quartz and silicified schist gravel, which hides the softer rock.

Blue Jacket (M.L. 632).

Location, Etc.

The Blue Jacket lies about 3 miles east of Mount Hope, among lowlying rounded, rolling but stony ridges.

The area is 5 ac.

Development.

The shaft, 15 ft. deep, is located centrally in the eastern part of the lease; from it a stope has been carried northwards the full depth for 12 ft., and at the bottom a drive is being carried still further north. The only other work done here is a trench 3 ft. deep running 12 ft. north of the stope.

Output.

3½ tons shipped, containing ... ... 26½% copper.

Ore-body.

The north and south striking shoot of ore is believed to be pitching northwards from the shaft, in the southern end of which is exposed 4 ft. width of calcite, with bunches of quartz-bearing limonite. This crop can be traced for 10 ft. south of the shaft.

In the northern end of the stope also a well-defined formation, carrying calcspar, occurs, but the ore in the floor of the drive has pinched to 6 in. in thickness.

In the northern end of the trench no limestone is visible, but the ore is 12 to 18 in. wide, and here comprises high-grade glance and tesselated glance-chalcopyrite, with bunches of quartz and tile ore veined with atacamite.

The ore at grass ready for bagging amounts to 3 tons. It consists in great part of dense glance and chalcopyrite with cuprite, radiating malachite and native copper in limonite stained with malachite. The association of native copper with calcium carbonate is to be noted as almost a general rule. One of the claim-holders showed me a sample of cuprite and native copper, which should yield over 80% copper, but the smelter's return for similar ore is alleged to have been only 26%, the reason given being that it should have been sent as matte. In addition to the above, there are 1½ ton bagged at the shaft and 7 bags of cuprite. The seconds, 6 tons, include limonite with malachite veins, impregnations and stains, and the heap ought to run over 15% copper. The 3½ tons of ore shipped from here yielded only 26½% copper, owing, some assert, to the inclusion of much barren ironstone.

The shaft is to be deepened, as, although the ore may be bunchy, the formation will go down. Still it must be acknowledged that no large output is to be expected.

Geology.

The country rock is a black chloritic schist, and in the western and northern part of the lease dykes of aplite are abundant. The crystals of pink orthoclase are especially well developed, often set separately in a matrix of quartz.

In the vicinity of Sergeant's Camp, ½ mile to the north-north-west of the lease, calcite veins are very abundant in dark schists, but ½ mile beyond the camp pegmatite dykes are again in evidence, here formed almost entirely of quartz, the felspar crystals being widely scattered.

Little Beauty (M.L. 568).

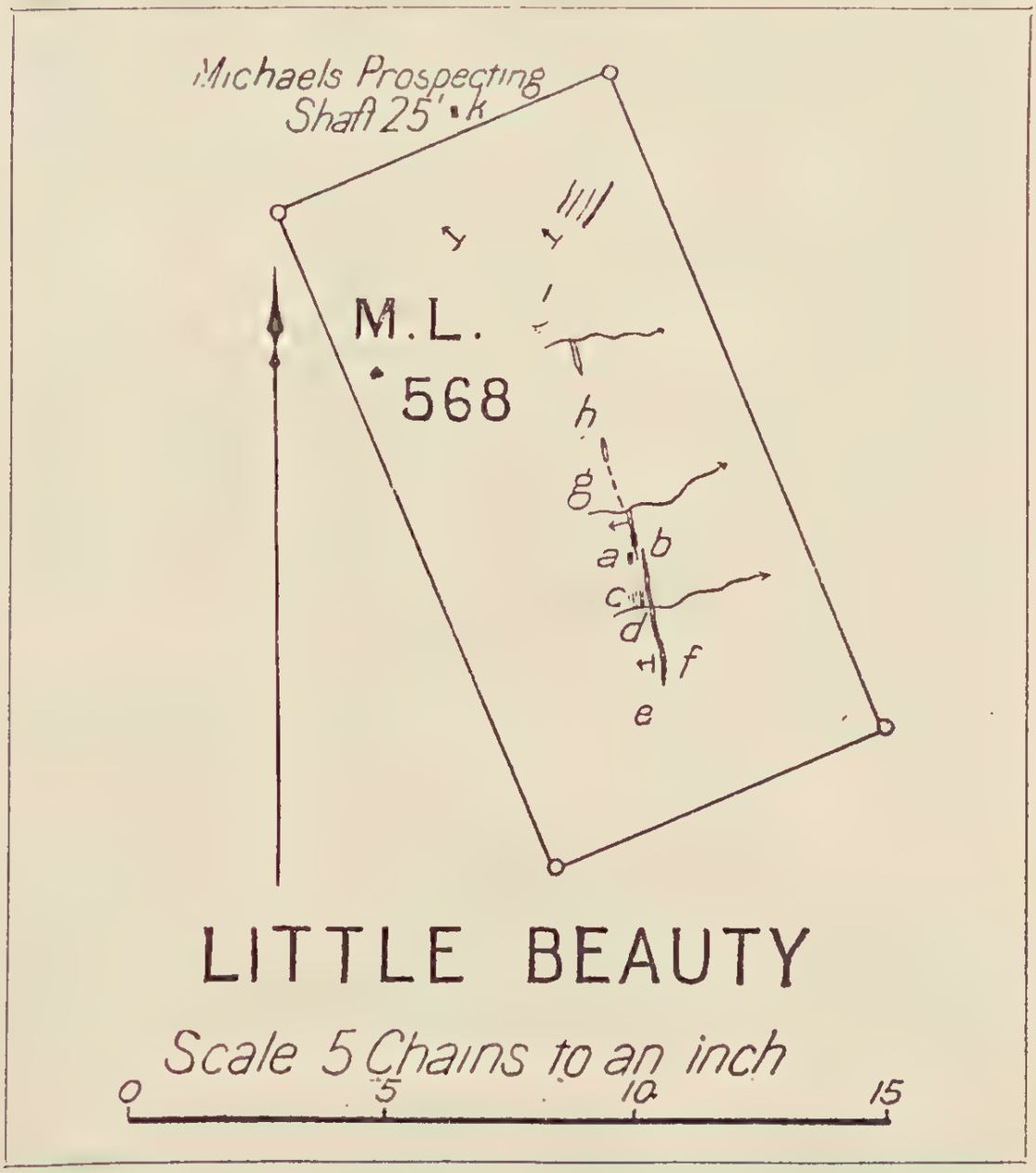
Location, Etc.

The Little Beauty lies 2½ miles east-north-east of the Mount Hope leases, and is directly connected by dray track with Smith's store, on the Urandangi road.

The area is 10 ac.

Development.

The workings, which are in the central southern part of the lease,



comprise only a trench 4 ft. deep and a shaft 50 ft. deep, with drives 10 ft. east-south-east and 12 ft. west-north-west.

Output.

1906 ... ... 2 tons shipped, containing 29% copper.

Ore-bodies.

The ore-bearing zone extends in a north-north-westerly direction over a distance of 7 ch., having a width in one place of 30 ft. Bunches of ore occur through this zone, but it is very doubtful if they are numerous enough for the deposit, as a whole, to be payably worked under any circumstances.

Beginning at the southern end, the country is stained with carbonates over a width of 15 ft., and has some bunches of fairly rich limonite-chalcopyrite-chalcocite ore, in addition to thin veins of gossan and quartz. At the gutter, 1½ ch. from the southern extremity, the formation contracts to 10 ft., and over 5 ft. width of country is included in this, but from the gutter for 30 ft. to the north the country is copper-bearing over 30 ft. in width. This formation should be trenched across in two or three places.

A promising gossan crop is then met, which can be followed northwards for 1½ ch., being 3 ft. wide near the centre.

Half a chain from the northern end of this crop it is over-lapped by another on the west. This is an irregular body of gossan quartz and copper ore (limonite with chalcocite and stains of malachite) 1 to 2 ft. wide, and from the trench opened on it 2 tons of 29% ore were obtained. It runs for only 1 ch. to the second gutter, beyond which only small bunches of gossan show at the surface for 1 ch., and then larger bunches, up to a few hundredweight each, of 10% gossan for ½ ch.

The country is then nearly barren for a distance of 1 ch., to a 12 in. crop of gossan extending 1 ch. to the third gutter. The schists 15 ft. to the north-west of this crop are stained over a width of 3 ft.

For 2 ch. north of the third gutter the country is slightly cupriferous over areas 10 ft. long and 2 ft. across, and one small patch of a few hundredweight of very siliceous carbonate stained limonite has been broken into. No other indication of copper can be found to the northwards on the line of strike, but the country here seems to have been abruptly deflected to the north-east, in which direction some gossany crops are to be seen.

Michael's prospecting shaft, to the north just outside the boundary, is 25 ft. deep. No crop shows here, and in the shaft only copper-stained decomposed gneiss is visible.

The main shaft has been sunk in the west of the overlapping outcrops. Ore comes in from the east at 25 ft. below the surface, and thence dips to the western side of the shaft at the bottom, where the body is nearly vertical. The eastern crosscut is in decomposing gneiss, streaked vertically black and white, but the western has pierced a well-defined formation 12 ft. wide. At least one quarter of the formation consists of bunches of malachite-stained limonite, containing chalcopyrite altering into chalcocite—the proportion of copper being perhaps 3%, but not more. It is noticeable here, as in many other places, that the smaller nodules are rich in secondary sulphides, the larger being more often poor limonite. The formation should be prospected by further sinking, as the percentage of copper may increase at a depth.

The country on the west at the southern end of the formation is altered gneiss and slate, with quartz lenses dipping 70° westwards; but further north silicified slates only are found; and, as mentioned, in the northern part of the lease, the strike changes to north-east. The country on the east is dark coloured gneiss. Aplite veins were noticed about a mile to the south-east of the Little Beauty. The rock is of somewhat striking composition, small crystals of pink orthoclase being scattered irregularly, and not very frequently, through a ground mass of quartz exhibiting a very distinct and unusual lamellar structure somewhat resembling the multiple turning of plagioclase.

The ore at grass not yet sorted, amounting to 3 tons, consists of tesselated ore (chalcopyrite altering into chalcocite) and malachite stained limonite almost free from quartz (that which is present being crystallised in cavities). It should average 20%, but probably 2 tons of 30% ore could be picked from it. The 10 tons of formation piled near the brace may carry 2% copper.

Mount Beauty (M.L. 705).

Location, Etc.

The Mount Beauty lies ¼ mile east of the Little Beauty.

Its area is 5 ac.

No work has yet been done.

Ardath (M.L. 656).

Location, Etc.

The Ardath lies between Green's Creek and the Urandangi road, ½ mile west of Smith's store and 4 miles south-east of Mount Hope.

The area is 10 ac. Exempt when visited.

Development.

The main shaft near the centre of the lease is 52 ft. deep (inaccessible), and another near the southern boundary is 20 ft. deep. Besides these there are four potholes 1½ ch. south of the main shaft and 1 ch. south-east of the southern shaft.

Output.

3 tons shipped (report).

Ore-bodies.

A crop of quartz and quartzite, striking north-east, comes into the lease from the south-west and peters out near the centre. The country for a chain to the south-east of this crop is much kaolinised, and carries bunches of good ore, over a length of 5 chains. The bunches are not, however, frequent enough for the whole belt to be mined nor large enough to warrant mining on a large scale for themselves.

The main shaft is sunk in kaolinised schist (stained bright yellow perhaps by traces of vanadium salts) containing 1 or 2% copper disseminated as carbonate with very occasional nodules of ore—malachite, chrysocolla and covellite (?), with inclusions of unaltered chalcopyrite reticulated with bluish chalcedony, probably introduced subsequently to the commencement of oxidation and tesselation of the chalcopyrite. A few hundredweight of earthy glance was got near the shaft bottom, and the proposal to continue sinking is sound, as much copper may have been leached downwards from the surface country.

The southern shaft proved 4 ft. in width of chloritic schist, stained and replaced by malachite and containing bunches of gossan and chalcopyrite altering into glance. It is reported that 3 tons of ore has been shipped from here; the 10 tons seconds at grass, cupriferous kaolinised country, probably average 5% copper.

In the pothole to the south-east of this shaft a width of from 1 to 5 ft. of kaolinised country is copper bearing. Some gossan was raised from here, but it is very siliceous.

At the pothole to the south of the main shaft there are several small gossan crops, and the holes, which went down in calcareous kaolinised country, struck occasional bunches of gossan carrying malachite and chrysocolla, sometimes with a little pyrite.

HAMPDEN.

Location.

The township of Hampden, which has an elevation of 1,200 ft. above sea level, is situated 40 miles due south of Cloncurry and 50 miles west of Mackinlay, the distances by road being 50 miles and 60 miles respectively. The Mackinlay road is very seldom used because of its crossing a rather abrupt range. Under this heading are included the Hampden Group and mines in its vicinity and the Monitor Group.

HAMPDEN GROUP.

The Hampden deposits are quite differentiated from most others in the Cloncurry district, by being stockworks primarily and also by their association with diorite.*

Hampden (M.Ls. 244, 245, Etc.).

(Mgr., C. L. Smith.)

Location.

The main workings are located within ½ mile to the north of the township.

Area.

The company (known as the Hampden-Cloncurry Copper Mines, Ltd.) holds a total of 260 ac.— viz., as adjacent leases: M.L. 244 of 20 ac. (part of Block 37); M.L. 245 of 20 ac. (part of Block 38); M.L. 405 of 20 ac. (now known as Block 38 east); M.L. 406 of 20 ac. (now known as Block 37 east); M.L. 408 of 80 ac. (known as the Hampden North); and M.L. 407 of 80 ac.

Most of the mining has been done on the first two, though some prospecting has been carried out on the Hampden North. M.Ls. 405 and 406 are held as works sites. For fluxes—limestone and ironstone—two leases have been taken up—viz., M.L. 421 of 10 ac. and M.L. 422 of 10 ac. (known as Mount Sylvia).

* Mr. Hartwell Conder, A.R.S.M., of Melbourne, has lately sent me some thin sections of specimens collected by him in the Cloncurry district. Examination of these with the microscope proves that certain rocks, resembling highly altered sedimentaries, found on the Argylla and Great Australia freeholds, are diorites, and the occurrence of that rock, altered to a greater or less extent, is, perhaps, much more widespread than was thought by me. Mr. Conder is now trying to trace the change from diorite to schist. Close study of limited areas may be expected to have some interesting results, among them being the proving that the copper has been derived from the diorite. The only hindrance to this work is the scarcity of outcrops of the country rock in the vicinity of the ore bodies.

Topography.

The Hampden Mines lie in a wide flat-bottomed valley of mature age, there being on the east only remnants, such as Mount Sylvia, of the old Cloncurry pene-plain, though more extensive ranges are found to the north-west. Gidia and stunted gum are the only timbers and they are not abundant.

History.

In 1884 Mr. Warden Uhr marked out two mineral leases, called Eureka, which would appear to have been on the Hampden crops.

The first official mention of the Hampden Mine is found in a report by Mr. W. W. Alder, for 1898, in which year a Melbourne syndicate began prospecting operations under the management of Mr. Godkin. Two shafts were sunk, 40 and 50 ft., and 20 trenches opened. Ten tons of ore were shipped and 100 tons stacked. Much prospecting was done in 1899, and the ore raised from the open cuts was graded.

Work in the open cuts was continued during 1900, though it was not possible to ship the ore raised, because of the drought. Early in 1901 work ceased, owing to continuation of the drought, but was resumed towards the end of the year, only to be again thrown over on the failure of the wet season in 1902.

Operations were not again undertaken, owing to the low market value of copper, till 1904, when contracts were carried out in shaft No. 12, after which a six months' tribute (No. 1) was given to Entriken and party of ten men, who operated in opencuts Nos. 1 and 2. On the expiration of Entriken's term, F. Ferguson took a six months' tribute (No. 2), and raised ore from shaft No. 7. During 1905 the Company carried on operations, but no work of importance was done, teams for the carriage of ore being still scarce.

Early in 1906 the Company was re-floated as the Hampden Cloncurry Mines, Ltd. (300,000 £1 shares), and a start has now been made to sink three shafts 200 ft., and block out the ore. The present hauling equipment consists of only one winch and boiler, but it is understood that two others are in transit to the mine.

Literature.

The full list of reports, numbered as below, will be found under the general introduction.

4. In his description, Mr. Cameron says "The Hampden Lode then appears to be a belt of vertical slates impregnated with cupriferous pyrites. Above the water-level the pyrites has been decomposed, and the copper concentrated into irregular masses by solution and redeposition from percolating water."

6. Mr. F. Stanley Low describes the workings in some detail, and mentions that the ore at grass comprised:

625 tons,	1sts	... ... 40%
2,691 ,,	2nds	... ... 13%
2,276 ,,	3rds	... ... 6½%

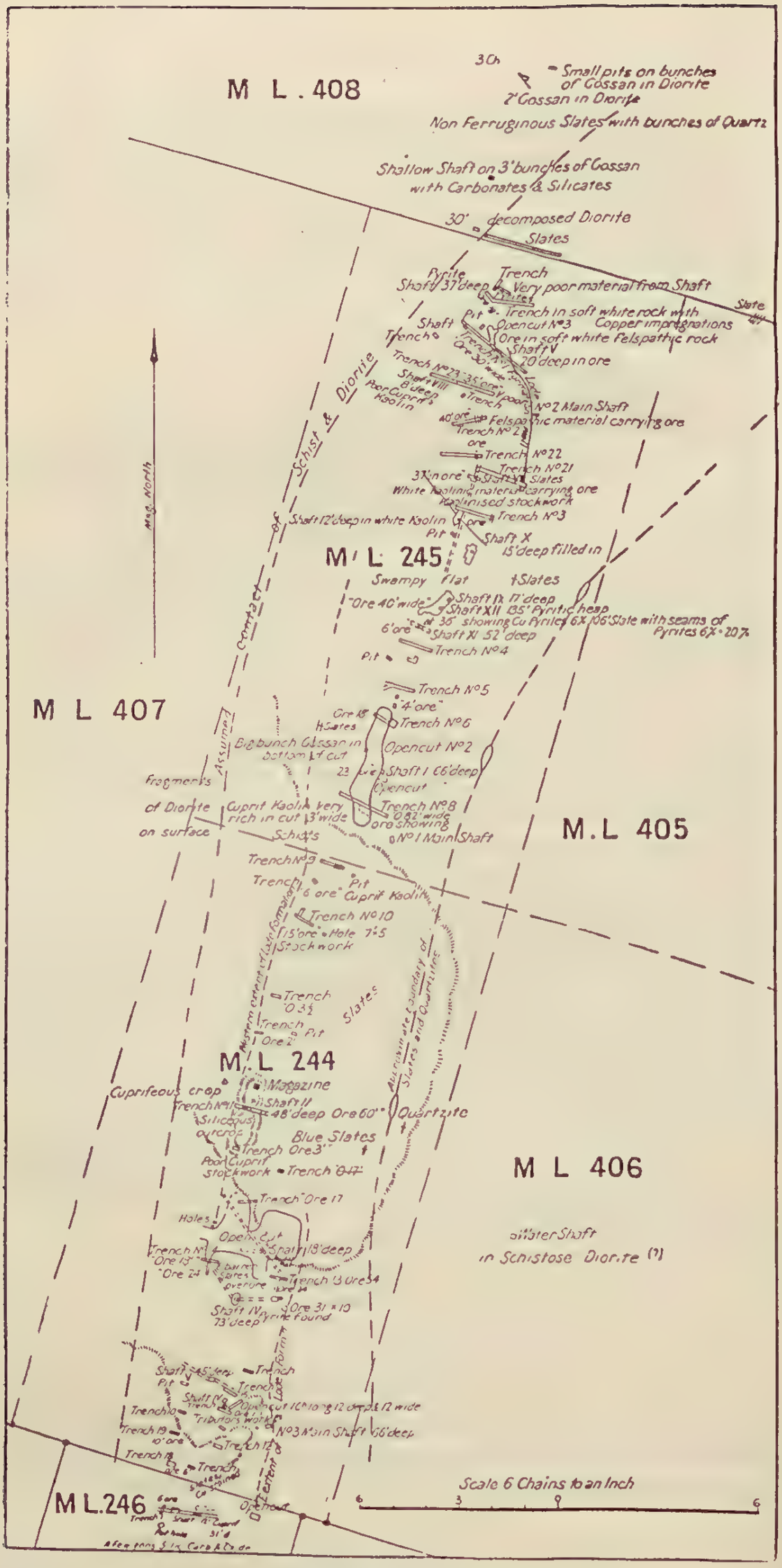
Mr. Low estimates the ore available for extraction as 116,000 tons, of an average grade of 15% copper, containing a gross value of £1,260,000.

8. A number of analyses, given in this report, are quoted below. Mr. Gibb goes into some detail as to the smelting qualities of the Hampden ores, showing that they require from 25% to 75% iron ore and limestone for fluxing, while the pyritic slate from No. 12 shaft would require no flux, "but, on the contrary, if this ore were proved to exist in sufficiently large proportion, it would, by the production of iron oxide in smelting, provide flux for the ore containing silica in excess, now rejected, and so reduce the cost of smelting the latter. . . . In the case of pyritic slate, represented by sample No. 27 from the Hampden Mine, no flux would be needed, and the smaller proportion of coke—as formerly explained—in pyritic smelting would reduce smelting cost to 22s. per ton." Mr. Gibb further estimates the profit per ton of ore to be £2 5s. 4d. He concludes that though the pyritic slate is very suitable for the cementation process, the cost of wet extraction including precipitant, would be £1 9s. 11d. per ton of ore, and, owing to the extreme slowness of natural oxidation, there would be no other advantage in adopting that process as against smelting.

9. Mr. Savage in a detailed report estimates that there is 183,000 tons of 11% ore in the kaolinised part of the lode, measuring 600 yds. long, 40 yds. wide, and 17 yds. deep.

Development.

It will be noticed that except at shafts VII., 1, 2, and 3 and open-cuts Nos. 1 and 2, little has been done here since Mr. Cameron's visit. Mr. Smith, though ill at the time, helped me in every way during my brief stay at the Hampden.



PLAN OF WORKINGS, HAMPDEN MINE.

Based on surveys by Thos. Fraser (1899), with additions by Walter E. Cameron (1900), and Lionel C. Ball (1906).

The workings extend from Block 15 on the south into M.L. 408 on the north, and comprise besides numerous pits, over 30 trenches, three opencuts, and 20 shafts, as shown on the accompanying plan by Mr. Fraser.

The trenches are from 3 to 200 ft. in length, and mostly less than 5 ft. in depth.

Open cut No. 1, near the centre of M.L. 244, is very irregular in form its greatest length being 3 chains and its width from 60 ft. to 140 ft., while its greatest depth is less than 20 ft. The cut is now being extended westwards.

Open cut No. 2 is 5 ch. in total length, but of this over a chain is simply an approach. Its average width is 40 ft., and its greatest depth is 30 ft.

Open cut No. 3, in the southern part of M.L. 245, is 40 ft. in length, and little can now be seen in it.

Shaft I. (in the side of open cut No. 2) is 66 ft. deep, and has short crosscuts east and west. Inaccessible.

Shaft II. on the ridge to the north of No. 1 cut is 84 ft. deep; at the 43 ft. level it has a crosscut 75 ft. to the west, and a drive 30 ft. to the south; and at the 84 ft. level a crosscut 65 ft. to the west. Inaccessible.

Shaft III. in No. 1 opencut was sunk 18 ft., and had a long crosscut running west-north-westwards.

Shaft IV. (near the southern boundary of M.L. 244) is 73 ft. deep, and has crosscuts 70 ft. east and 70 ft. north-west at the 60 ft. level. Inaccessible.

Shaft V. in the southern part of M.L. 244 is 45 ft. deep, and has crosscuts 40 ft. east and 60 ft. west. Inaccessible.

Shaft VI. 20 ft. deep with crosscuts 30 ft. in length at the bottom is at the south-eastern end of opencut No. 3. (It is incorrectly marked V. on the attached plan.) Inaccessible.

Shaft VII. in the northern part of M.L. 245 is 54 ft. deep and at the 50 ft. level has drives 60 ft. north and 150 ft. south with crosscuts 160 ft. east and 45 ft. west, at 20 ft. south of the shaft. In the western crosscut at 60 ft. from the main drive there is a 41 ft. winze.

Shaft VIII., in trench No. 23, is only 8 ft. deep. Inaccessible.

Shaft IX. in the centre of M.L. 245 is 19 ft. deep. Inaccessible.

Shaft X., ½ ch. to the north, is only 15 ft. deep and is filled in.

Shaft XI. is 52 ft. deep, and has cross cuts 20 ft. east and west. Inaccessible.

Shaft XII., between 9 and 11, is 135 ft. deep. A small winch has been installed here, and the shaft was being unwatered by baling in January, 1907, when an inspection was made—under difficulties. At the 80 ft. level there is a drive to the south off the western crosscut,

and a drive for 45 ft. north from the shaft. At the 100 ft. level there is a crosscut in 15 ft. to the east, and a drive for over 100 ft. north of the shaft. A winze extends from the 80 ft. level to the 120 ft. level.

No. 1 main shaft is located off the lode in M.L. 245, near the dividing line with M.L. 245. It is now 40 ft. deep.

No. 2 main shaft has already been sunk 66 ft.—*i.e.*, to water-level.

No. 3 main shaft has also reached water-level.

These three shafts (each 12 ft. × 4 ft. in clear) are to be sunk to 200 ft. below the surface, and connected by driving, after which the deposit will be blocked out and sampled.

The well on M.L. 406 is 70 ft. deep in chloritic schist, and has a drive 40 ft. in length. The supply is 60 gall. per hour.

The workings on the Hampden North, all adjacent to M.L. 245, include several potholes and trenches, and one shaft 30 ft. deep.

Output.

		Tons.			£	s.	d.
1898—		10	37%	copper			
1901—2nd quarter	Co.	314 19/20	37%	,, valued at	9,646	0	0
—3rd ,,	,, ...	198	36%				
1902—							
1903—							
1904—	Trib. No. 1 ...	118 19/20	30%		2,148	8	0
	,, No. 2 ...	29	30%		546	0	0
1905—	,, No. 2 ...	13	30%		269	2	6
	,, ,, ...	131			3,026	10	0
(Ferguson)	,, ,, ...	11 19/20			252	18	0
	Co.	16			316	16	0
1906—3rd quarter (Ferguson)	...	41			984	0	0
		12					
Total		924 19/20					

The seconds now at grass amount to:

8,600 tons, containing ... ... 10% copper*

Geology.

The Hampden deposits collectively have been usually referred to as a lode, though it has also been pointed out that they occur in a belt of slates between diorite on the west and quartzite on the east. Outcrops of the former are not by any means abundant except in the Hampden North, where the rock is slightly schistose. A dark schist found in the Hampden well may also be an altered diorite, but, as the Geological Survey Office is not provided with a lapidary, it has not been possible to make a petrological examination. The mine plan shows a zone of slates from 500 to 1,000 ft. wide, while that accom-

* The heaps are now being sampled under Mr. Smith's direction. The assays have thus far proved the ore to carry up to 9 dwt. of gold per ton.

panying Mr. Cameron's report shows a belt with a uniform width of 350 ft. As a matter of fact, in spite of the multitude of workings, the exact width of the ore-bearing country has not yet been determined.

In the trenches and open cuts the country can be seen to be cupriferous over widths of from 3 ft. to 3 ch., and two parallel well marked copper-bearing zones, 1 to 2 ch. apart, can be traced through the leases, with interruptions and possibly in one or two cases coalescing; but there is no indication that the ores have infilled open channels, which would constitute a lode in the accepted sense. The ores near the surface occur as bunches and irregular veins in kaolinised slates, and the deposits should therefore be designated a stockwork.

The ore near the centres of the bunches is pure chalcocite, but outwards it gradually becomes impure, and ultimately shades into stained kaolin.

The richer ores have been found in only four circumscribed areas —probably the outcrops of shoots which, there is some evidence to show, are pitching southwards. The work done in shaft No. 12 indicated that secondary enrichment has taken place to a depth of at least 100 ft. in the country between the shoots. Consequently no considerable diminution of the average amount of copper per cubic yard is to be anticipated in the richer shoots for 100 ft. beneath the surface, the ores near the surface being richer but more scattered than in the neighbourhood of the water level.

The Hampden deposits have some resemblance to those worked at Clausthal, in the Hartz*, where occur zones of altered rock (clay slates, dipping slightly but foliated parallel to a plane of movement), 66 to 262 ft. wide, extending as far as 9 miles, and in which the ore bodies are somewhat irregularly distributed. The zones are the result of the friction of great masses which have been rubbed together. Galena pyrite and blende are the chief ores.

The occurrence of hæmatite at Mount Sylvia, in the immediate vicinity of Hampden, points strongly, however, to the ore-bodies being due to regional metamorphism of originally cupriferous eruptive rocks—the "diorite" found within short distances of the main workings. These conditions are not unfavourable for permanence in depth, as the copper derived from these rocks has been deposited in a crushed (schistose) zone traceable for long distances along the surface, and for that reason likely to descend below the limits of practical mining.

Ore Bodies.

The trenches have been opened for many years, and the exposures are therefore now not of the best; but in most of those on M.Ls. 244

* Genesis of Ore Deposits. By Prof. Franz Posepny, p. 79.

and 245 cupriferous (carbonate) bands of country can be distinguished, and from many of them fair quantities of ore have been taken. The open cuts (Nos. 1 and 2), however, afford valuable information as to the nature of the deposits.

Open cut No. 1 is on the site of the richest area of ground yet located at Hampden. The ore, of which indications were first found by trenching and crosscutting from shaft III., consists of irregular bunches of cuprite and glance in kaolinised slates probably forming an indistinct shoot at least a chain wide pitching southwards beneath barren kaolin forming the southern side of the cut. The ore raised prior to 1901 from the cut, of which only the firsts have been shipped, comprised:

280 tons	... ...	40%
1,500 ,,	... ...	13%.
55 ,,	... ...	6½%

Further quantities were obtained by the No. 1 tributers in 1904, and in removing the overburden west of the cut the manager is now recovering some rich ore. At the time of my visit in January 50 tons had been stacked. In this are scattered irregularly shaped kernels of cuprite, surrounded by encrusting laminated chrysocolla gradually passing outwards into slightly stained kaolin (Fig. 4).

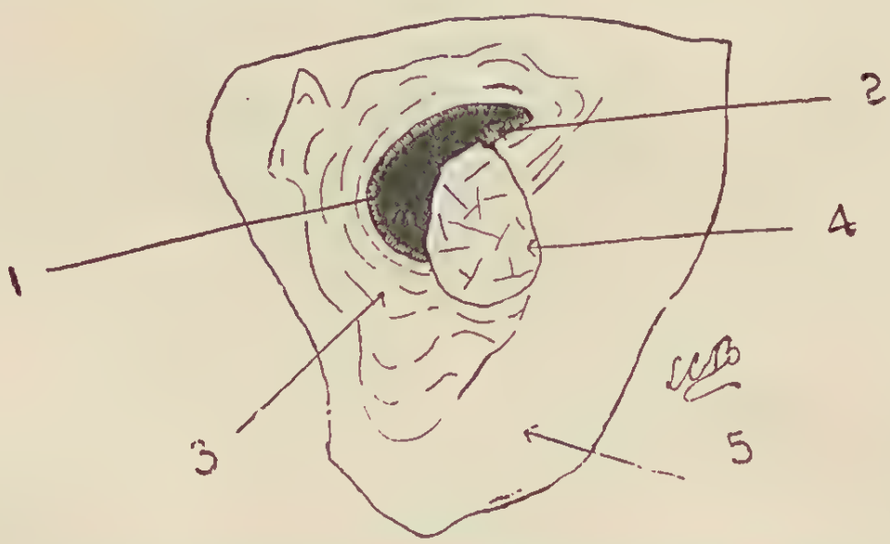


FIG. 4.—(NATURAL SIZE), OXIDISED ORE, SURFACE, NO. 1 OPENCUT, HAMPDEN.

1. Crystalline cuprite.
2. Band of chrysocolla, blackened by cuprite.
3. Laminated chrysocolla.
4. Slightly stained ferruginous quartz.
5. Kaolin, slightly stained with chrysocolla, manganese dioxide and ferric oxide.

Opencut No. 2 is in kaolinised slate with veins and bunches of carbonate stained cuprite and copper glance, forming a stockwork. There was little or no sign of ore at the surface, and the present faces do not appear to be worth more than 5% copper, though

the ground is believed to be richer underfoot. Still, breaking down is to be continued, as the tributers last working naturally left only the poorest ore standing. The ore raised from the part of the cut north of shaft I. prior to 1901 included:

200 tons	40%
364 ,,	13%
1,184 ,,	6½%

The No. 1 tributers during 1904 extended the cut, and considerably augmented the heaps of ore at grass.*

Near the bottom of the cut is a body of gossan, in the interior of which some pyritic ore was found. This was originally chalcopyrite. It presents the appearance of having been cracked in all directions and subjected to leaching along the faces formed. Some of the copper has been redeposited in the openings as glance and cuprite, while oxidation has taken place to malachite and tenorite. The ore therefore, though at first glance thought very poor, proves to be moderately high in grade.

Opencut No. 3 yielded previously to 1901:

7 tons	40%
28 ,,	13%
8 ,,	6½%

besides which rich ore is reported underfoot. The cut exposes a kaolinised stockwork.

In shaft I. a body of glance was struck, yielding 75 tons of 20% ore.

In shaft II. white kaolin, with bunches of pyrite (carrying 1% copper) was found below black slate, with pyrite on joints.

Shaft III. proved the rich ore afterwards worked in open cut No. 1.

In shaft IV. rich ore was struck in sinking, and pyrite is also reported from it. It is understood that the slates dipped steeply west-

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* Mr. Gibb tabulates the following analyses of ore from No. 2 opencut (Government Analyst):—

S = selected for shipment.
R = rejected from ore raised.

	S.	S.	R.	R.
Copper	32·1	42·1	24·1	11·0
Silica	31·2	19·2	38·4	52·9
Iron protoxide	4·6	7·6	5·5	3·5
Alumina	8·8	4·3	8·6	13·9
Lime	trace	trace	0·5	0·5
Sulphur	—	6·4	—	—
	76·7	79·6	77·1	81·8
Gold	trace			
Silver	9 dwt. per ton.			

wards in the western crosscut. The ore-body was reported in 1900 to be 70 ft. wide at the 60-ft. level, and to assay up to 20%.* The total raised was:—

13 tons	... ...	40%
28 ,,	... ...	13%
197 ,,	... ...	6½%

The ore at grass consists of kaolinised slate with veins of carbonate-bearing kaolin passing into fairly rich oxide and glance ore.

Shaft V. was sunk in ore, but no classification was made of it. The manager in 1900 reported 111 tons of 13% ore at grass.

In the shaft VI. 30 ft. of ore was reported in the crosscuts.

In sinking VII. shaft a large body of ore was met, and the ore raised comprised:

12 tons	... ...	40% ore
72 ,,	... ...	13% ,,

During 1905 and 1906 an additional 200 tons of ore—black oxide (?) and glance, with stains of malachite—running from 38 to 51% copper, was broken down in the stopes just north of this shaft. It was possible to descend these stopes to the 50 ft. level, and it was then found that the irregular ore-body worked in the stopes had been driven on for 40 ft. north of the shaft, beyond which the country is only slightly stained but kaolinised. South of the shaft kaolinised slates, dipping 80° to the east show only occasional signs of ore, but there is a cap of gossan half-way along the drive. There is a possibility of bodies being tapped by short crosscuts, and the gossan cap should be sunk on. In the western crosscut only a few small patches of gossany ore were found, but in the eastern, at 60 ft. from the shaft, a body 30 ft. in length and 6 to 15 ft. wide, has been stoped out. This was sunk on by winze to 22 ft. below the crosscut. Beyond the stope only barren black slates, with bands of white kaolin, can be seen.

Shaft VIII. does not appear to have yielded any ore.

In shaft IX. no ore of consequence was found.

Shaft X. simply gave promise of ore.

Shaft XI. did not strike any body of importance.

In shaft XII. the former manager found the copper-bearing slates, at 50 ft. depth, to assay 9·% copper; at 59 ft., pyrite associated with gossan—assaying 6·5% copper—was struck; at 72 ft., the pyrite assayed 27·4%; at 74 feet, a vein of pure glance was cut; at 75 ft., the pyrite assayed 22·4%; at 82½ ft., 21%; at 97 ft., 6·2%; and at 107 ft., 4·2%. The workings had not been cleaned up when inspected by me, and my examination was therefore imperfect;

* Report by Mr. Godkin to the directors.

but at the 80-ft. level friable pyrite* as bunches and veins, with some coatings of secondary sulphide, could be seen in kaolin, the whole apparently a partly oxidised and leached stockwork.† On the 100-ft. level sulphides can be seen near the shaft, but the northern drive shows little sign of ore, the country being slate. The northern drive on the 100 ft. level is in slate.‡

No. 2 main shaft struck siliceous gossan dipping west and pitching south at a depth of 45 ft.

No. 3 main shaft has as yet proved only barren slate.

Most of the workings on the Hampden North are in diorite, in which small and irregular bodies of gossan can be seen, in one place carrying both malachite and chrysocolla. The slates would appear to have been deflected to the north-east, where some prospecting should therefore be done.

Probable Ore.

The first rich area may be taken to extend from open cut No. 1, near the northern boundary of M.L. 245, almost to shaft No. 10—a distance of 450 ft.; and it has been proved in places to be 30 ft. wide, while it may have double that width in others. The second (at opencut No. 2), in M.L. 245, is 400 ft. long, and up to 40 ft. wide. The third (at opencut No. 1), in M.L. No. 244, is 300 ft. long and 200 ft. wide. The fourth, at the southern boundary of M.L. 244, is 200 ft. long and 20 ft. wide. These areas, it must be understood, are exceedingly ill defined, and the amount of ore available is very problematical.

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* Analysis given by Mr. Gibb, of "pyrite" (Government Analyst) :—

Copper	=	0·3 %	
Silica	=	11·0	
Iron protoxide ...	=	48·1	Gold = trace
Alumina	=	4·1	Silver = trace
Sulphur	=	37·6	
		101·1	

† Analysis, tabulated by Mr. Gibb, of "pyritic slate" from drives at the 80 ft and 100 ft. levels, No. 12 shaft (Government Analyst):—

Copper	=	10·5	
Silica	=	13·1	
Iron protoxide ...	=	39·8	Gold = 10 gr. per ton
Alumina	=	6·6	Silver = 1 oz. 0 dwt. 14 ,, ,, ,,
Sulphur	=	27·3	
		97·3	

‡ Analysis, given by Mr. Gibb, of "country rock" (Government Analyst) :—

Copper	=	0·8 %
Silica	=	57·1
Iron protoxide ...	=	7·5
		65·4

Taking the areas given above, the total material in the shoots above the 100-ft. level, assuming 15 cub. ft. per ton, will be 625,000 tons. The ore taken from the open cuts, reduced to a 10% basis, amounted to two-thirds of the material moved. But there is a likelihood of the average being below this, and, for purposes of illustration, placing it at one-sixth, the probable amount of 10% ore above the 100-ft. level will be 100,000 tons. The total quantity of ore in the shoots may be much less than this, but will then be of correspondingly higher grade.

Treatment.

Till recently, with cartage to Hughenden costing £8 per ton and railway and shipping freight 30s. extra, the total cost of mining, transporting, and treating (at customs works) a ton of 30% ore has amounted to nearly £14; and even with the railway at Cloncurry and cheapened mining costs it is likely to still reach £8. At the present time nothing less than 20% is bagged, and even with copper at £100 per ton nothing less than 10% ore would pay to ship, and a slight fall would necessitate closing down the mine.

The company has therefore always desired concentration, but their ores, so far proved, are chiefly oxidised, and not suited for vanning, and they now propose to erect smelters. The scarcity of timber in the district is a recognised difficulty, but it is hoped to make up for this deficiency by the addition of sulphides from the lower levels.

None of the wet processes have yet been considered, but that known as Neill's should certainly be given a trial. In this process the sulphur dioxide given off during roasting is used to dissolve oxides and carbonates as sulphite, which is precipitated by heat and reduced to metallic copper simply by fusion, sulphur dioxide being regenerated*.

Block 15 (M.Ls. 246 and 409).

Mgr., Hogarth.

Location, Etc.

Adjoining M.Ls. 244 and 406 (Hampden) on the south.
Each lease is 10 ac. in extent.

Workings.

The workings, which are all on M.L. 246, comprise a number of potholes in the northern part of the lease, several trenches, an open-cut, and two shafts. The inaccessible main shaft near the centre of the lease is 80 ft. deep, and has a crosscut running 170 ft. to the west. The second shaft has only just been begun, about 5 ch. north of the main shaft, and when inspected there was one man at work here.

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* See Wet Processes of Copper Extraction. By L.C.B. G.S.Q., No. 193.

ORE DEPOSITS.

At the southern end of the lease there are crops of ferruginous clay slates over a width of two chains, with blows of siliceous gossan 6 ft. thick and a chain long, two chains apart. The main shaft was sunk alongside one of these blows, in black pyritous slates dipping steeply to the east, but failed to prove it continuous downwards, and in the crosscut only slates were found—dipping steeply west.

In the open cut, near the northern boundary and east of any of the Hampden workings, black slates occur, veined with green carbonate and strongly impregnated with chalcocite over a width of 10 ft. (Fig. 5).

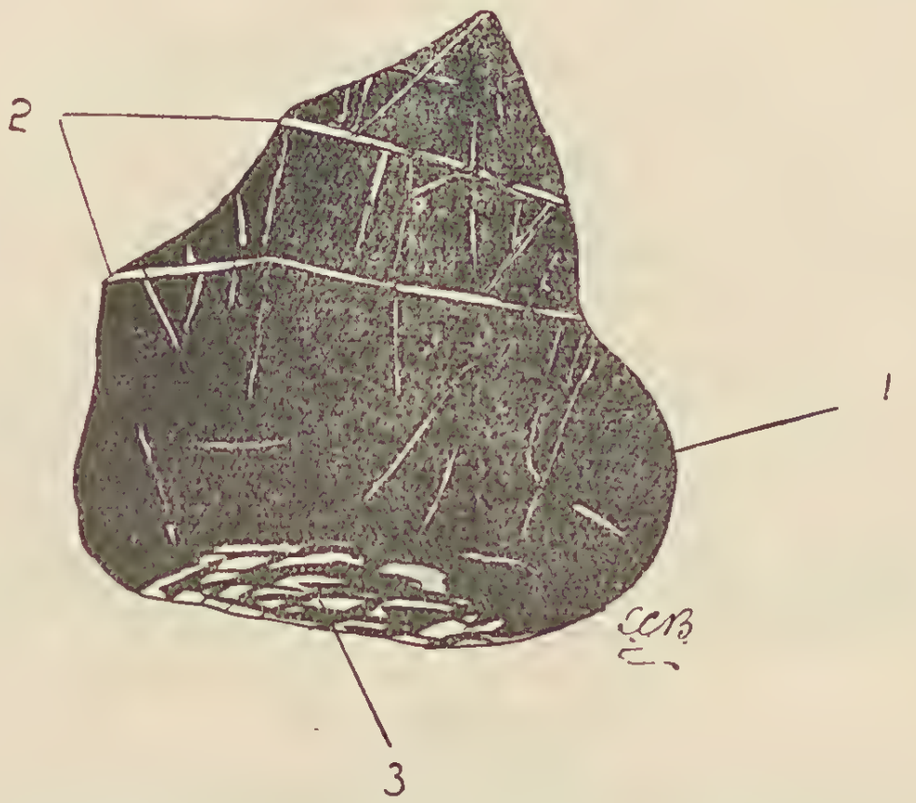


FIG. 5.—(NATURAL SIZE), STOCKWORK, OPENCUT BLOCK 15.

1. Black slate, with disseminated chalcocite. *2. Malachite.*
3. Malachite replacing slate.

The trench to the west of this exposes slate, veined and impregnated with carbonate and oxide. About 30 tons of ore has been stacked, probably containing 5% copper.

Two chains south of this is another trench and shaft, where silicified gossan is visible at the surface; while below is limonite with quartz crystals and stains of malachite. There is about 20 tons of 1% ore stacked here.

There is thus—except the chalcocite slate in the open cut—nothing of present value showing on Block 15, though copper ore may be found beneath the gossan; but there is some hope of the southernmost shoot of rich ore in M.L. 244 pitching into this property at a depth.

Mount Sylvia (M.L. 422).

Location, Etc.

Mount Sylvia lies about 1½ miles south-east of the Hampden workings.

This lease of 10 ac. is held by the Hampden Company for ironstone flux.

Ore.

Mr. Smith informed me that the ore assays 87·87% iron oxide. Specimens given me consist of non-magnetic crystalline granular hæmatite, with thin veins of limonite. The association of hæmatite deposits with those of copper is suggestive, again, of a genesis due to regional metamorphism.

Hampden South Extended (M.L. 394).

Location, Etc.

Adjoining M.L. 246 on the south.

Its area is 10 ac. Unmanned when inspected.

One trench 2 ch. from south-western corner on the southern boundary is the only development.

Deposits.

In the trench 2 ft. of limonite, with secondary silica, can be seen, as well as on the surface for a few chains to the north. This is probably only a bunch, but is worth sinking on, being on the continuation of the Hampden line.

Another crop of quartz-bearing gossan, lying 5 ch. north of the above, should also be tested.

Block 25 (M.L. 421).

Location, Etc.

This lies 7 ch. west of the north-west corner of M.L. 407.

Its area is 10 ac. This lease is held by the Hampden Company for limestone flux.

Deposits.

In the north-western corner a crop of calcite can be traced for about a chain in decomposed diorite. It is 18 in. thick, and dips northwards. The calcite is accompanied by quartz (which appears to increase in depth) as well as small patches of limonite and occasional flakes of chlorite.

Ten chains west of the above is another crop of grey calcite, 2 to 3 ft. wide, and vertical, striking east and west. It has been trenched for 1 ch., and can be traced for ½ a ch. beyond.

Other small crops may be found, but no large supply of limestone is to be expected here.

Hampden South Extended Block (M.L. 410).

Location, Etc.

This adjoins M.L. 394 on the east.

The area of the lease is 10 ac., but there are no workings, and no deposits have been exposed. No one was present on the ground when my inspection was made.

Hampden Central (M.L. 501).

Location, Etc.

This adjoins M.Ls. 394 and 410 on the south.

The area of the lease is 31 ac. The workings comprise only one trench, and the lease was deserted when visited.

Deposits.

Only thin veins of carbonate in slate have yet been found here—nothing of importance.

Hampden South (M.L. 502).

Location, Etc.

The Hampden South adjoins M.L. 501 on the south.

Its area is 31 ac. The lease was unmanned when inspected, but Mr. Hazard, one of the former owners, conducted me over it.

Workings.

Three trenches and two potholes. Pothole (*a*), 4 ft. deep, is 5 ch. from the southern boundary; trench (*a*) is $\frac{3}{4}$ ch. to the north; shaft (*b*), 10 ft. deep, is $\frac{1}{2}$ ch. beyond; trench (*b*), 6 ft. deep, is $\frac{1}{2}$ ch. beyond; and cut (*c*) is 5 ch. further north.

Ore Deposit.

The crop is a well marked one of ferruginous quartzite passing into siliceous limonite and gossan (generally with a body of cellular limonite on the east), standing in some places 5 ft. above the ground, and exposed for a length of 12 ch. from the southern boundary. Its dip seems to be to the east.

The main workings are along the eastern side of the crop, adjacent to where the crop is most siliceous. The main shaft (*b*) is sunk wholly in cellular limonite, with quartz crystallised in cavities, and containing disseminated malachite. About two tons of 15% ore have been paddocked, while 7 bags of picked ore are reported to have yielded 20%.

The deposit should be sunk on where less siliceous, as such cellular limonite must overlie copper ore—probably of some richness.

The country rock near the crop is slate, but diorite occurs within a few chains to the north-east.

Azurite (M.L. 561).

Brady and McBride.

Location, Etc.

The Azurite lies 4 miles east of Hampden.

Its area is 5 ac. It was not visited.

Carbonate (M.L. 558).

Brady and McBride.

Location, Etc.

The Carbonate adjoins the Azurite on the east.

Its area is 5 ac. It was not visited.

True Blue (M.L. 591).

Grey and Wheatley.

Location, Etc.

The True Blue lies $1\frac{1}{2}$ miles west-north-west of the Azurite.

Its area is $9\frac{8}{10}$ ac. It was not visited.

Block 33 (M.L. 247).

Mgr., Orr.

Location, Etc.

Block 33 (or the Hampden West) lies $3\frac{1}{2}$ miles west of Hampden.

Its area is 10 ac.

Output.

1904	...	15 tons	shipped	
1905	...	6 ,,	,,	by Woodhouse and Tait
		12 ,,	,,	,, Salveson
1906	...	22 ,,	,,	,, Woodhouse and Tait.

I.X.L. (M.L. 389).

Mgr., Long.

Location, Etc.

The I.X.L. is understood to lie $3\frac{1}{2}$ miles north-north-west of Hampden.

Its area is 9 ac. It was not visited.

MONITOR GROUP.

This group, lying 44 miles south of Cloncurry, includes the Monitor, Monitor North, Monitor South, Wooluma, Gorge, and Mount Devoncourt. The first is in slate country, but the last is reported to be in porphyry.

Monitor (M.L. 419).

Mgr., McEvoy.

Location, Etc.

The Monitor is 44 miles south of Cloncurry, 8½ miles southwest from Hampden, and ½-mile from the Cloncurry River.

The area of the lease is 5 ac.

Development.

The main shaft is 40 ft. deep; down to 15 ft. it is 10 ft. wide and 20 ft. long, and below it is 5 ft. wide and 10 ft. long. Only one other trench, 2 ch. to the south-east, was seen.

Output.

Total—65 tons despatched, 30 to 40 % copper (*fide* Mr. McEvoy).

There are no returns in the Warden's reports of ore from the Monitor.

Ore-bodies.

In the southern trench a gritty kaolinised rock striking north-north-east is exposed. This rock shows flakes and stains of malachite, but the average tenor of copper is below ½%.

Northwards towards the main shaft ferruginous quartzite crops out alongside schistose slate, and at the shaft schists and quartzites over a width of 10 ft. have been irregularly impregnated and replaced by copper ore. Near the surface the rocks are stained by malachite and azurite and carry bunches of ore (limonite, malachite, and glance). The dark chloritic schist towards the shaft bottom is reticulated by thin veins of malachite, and contains splashes of glance, the ore on the whole being rather better than that above.

Some 65 tons of 30 to 40% ore have been despatched, and the seconds—dark slate with malachite and azurite stains—amounting to 150 tons, should contain 5% copper. There is also at the brace 3 tons of ore last raised—comprising black schistose quartz-veined slate, seamed in all directions by malachite (as on Hampden Block 15), and carrying a few bunches of tile ore. This, as it stands, should assay over 10 per cent. copper.

Monitor North (M.L. 533).

Location, Etc.

This adjoins the Monitor on the north.

Its area is 5 ac. No work has been done on this.

Monitor South (M.L. 534).

Location, Etc.

This adjoins the Monitor on the south.

Its area is 5 ac. No developments have yet taken place here.

Mount Devoncourt (M.L. 550).

Mgr., Staubwasser.

Location.

Mount Devoncourt lies 12 miles south-east of Devoncourt, on the main branch of the Cloncurry River, 2 miles from the Hampden road, and 42 miles south slightly west from Cloncurry. It is not shown on the lease map.

The hills both north and south of the Cloncurry River rise to a fairly uniform elevation of about 100 ft. above the flood plain, of the Cloncurry River and mark the level of a peneplain, out of which the river has cut its valley.

Area.

The area is 10 ac. The lease was taken up under the name of Mount Merlin, but is more commonly known as the Devoncourt. It is rumoured that the Mount Merlin Company has abandoned the mine, but the manager's reports make it unlikely to be the case.

The mine was deserted during my stay in the locality, and an attempt made to locate it proved unsuccessful, owing to inadequate directions.

Development.

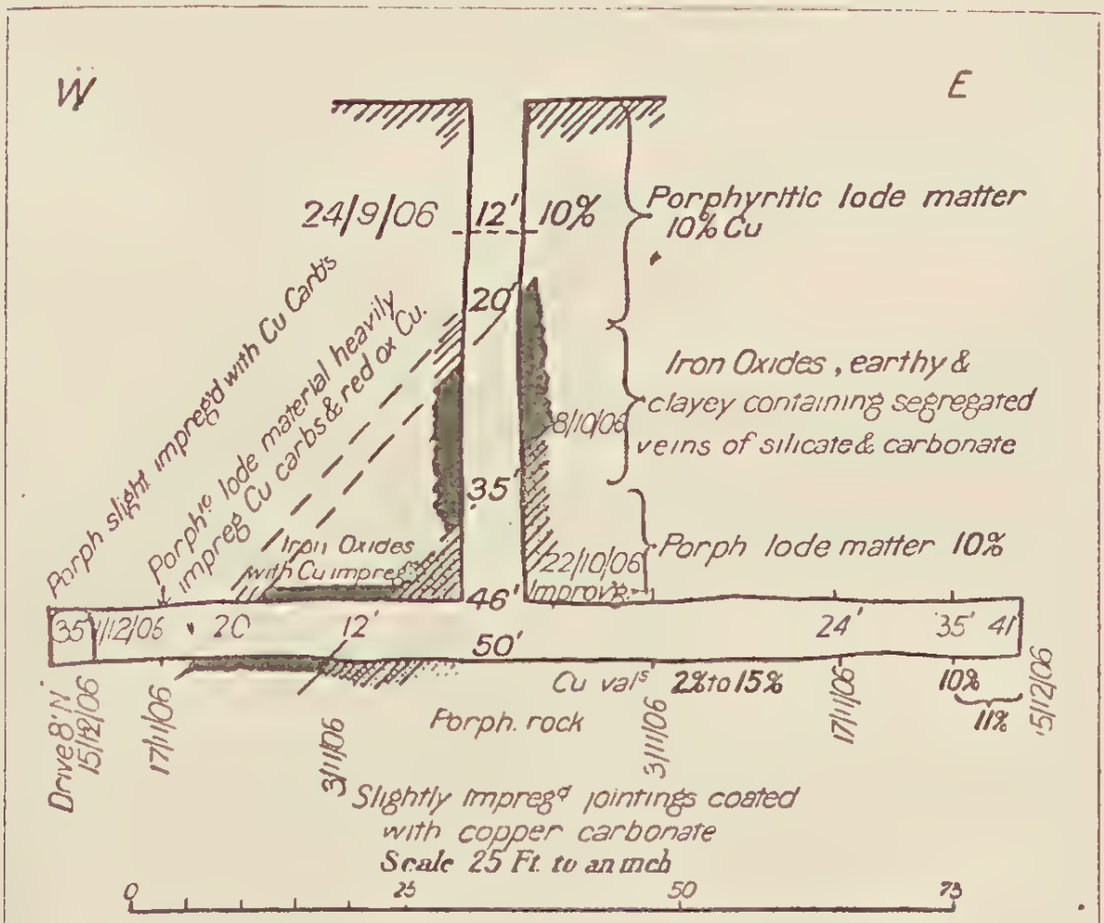
From the manager's reports published in the Brisbane Press, it is learnt that the company began work in September, 1906, cleaned out an old shaft 12 ft. deep, continued sinking to 50 ft., and then at the bottom opened crosscuts 41 ft. east and 35 ft. north, also driving 8 ft. north from the end of the latter.

Ore-body.

It is understood that there was no ferruginous crop at the surface, but the several costeans "show a wide and lengthy expanse of cupriferous material."

The shaft, sunk apparently near the centre of the ore-body, proved "porphyritic lode material," assaying 10% at 12 ft. depth. From 20 to 35 ft. the sinking was in "iron oxides, earthy and clayey, containing segregated veins of hydrous copper silicates and carbonates." Below the ironstone there is again, as above, porphyritic

material carrying 10% copper to 46 ft. depth, but the porphyritic rock in the shaft bottom is only slightly impregnated, though the jointings are coated, with copper carbonate.



SKETCH SECTION OF MAIN SHAFT, MOUNT DEVONCOURT.

The western crosscut is in "iron oxides, with small patches of copper impregnations" for from 12 ft. to 20 ft. from the shaft, and adjacent to this body is "porphyritic lode material heavily impregnated with copper carbonates and red oxide of copper," but the drive at the end of the crosscut is "in porphyry, slightly impregnated with copper carbonates."

In the eastern crosscut the amount of copper gradually increased with distance from the shaft, and between 12 ft. and 24 ft., it varied from 2 to 15%, the average of the last 6 ft. being 11%.

From these data it would appear that there is a gossan body, 10 ft. thick, dipping westwards through the shaft and the western crosscut. This, if correctly described by the manager, should prove rich in copper above water level, below which cupriferous pyrite may be expected. The whole formation exposed on the 50 ft. level would appear to be a deposit of some promise, the manager's statement being: "At the 50 ft. level we have a copper-bearing formation 70 ft. wide, with ore still showing in the eastern face of crosscut. The copper occurs as an impregnation of porphyry, the copper content varying from 2 to 14%."

During my search for the mine it was noted that the country in this vicinity comprises felspathoid and granitoid rocks—apparently highly metamorphosed sedimentaries, with interbedded crushed porphyries. Attention has elsewhere in this report been drawn to the importance attached to low-grade chalcocite deposits in porphyry at Ely, Nevada, U.S.A., where in one mine the rock has been leached from the surface to 50 ft. or 100 ft. below, but still deeper has uniform though low copper values.

Wooluma (M.L. 631).

Location, Etc.

The Wooluma lies ½ mile north of the Monitor.

Its area is 10 ac. It was not visited.

Ore-bodies.

This lease is believed to be on the coutinuation of the Monitor line.

The Gorge (M.L. 484).

Location, Etc.

The Gorge is believed to lie 1½ mile west of the Monitor.

Its area is 20 ac. It was not visited.

FLORENCE RIVER.

The Florence mines are rather scattered. They comprise only 2 leases with 19 claims and 3 prospecting areas.

The following is a list of holdings in force at the end of the year 1906, of which the particulars available do not warrant their treatment under separate headings.

McPhail North (M.C. 200).—This adjoins the McPhail on the north. Its area is 800 ft. × 350 ft. No work has been done here.

McPhail South (Extended M.C. 234).—This adjoins the McPhail on the south. Its area is 800 ft. × 350 ft. No work has been done on it.

Edmonson (M.C. 222).—The Edmonson is near the McPhail. Its area is 1,600 ft. × 350 ft.

Dodger (M.C. 371).—The Dodger lies 3 miles south-east of the McPhail. Its area is 400 ft. × 350 ft.

Bobby Dazzler (Extended M.C. 365).—This is 2 miles north-west of Native Police Waterhole, Florence, and about 5 miles east of the McPhail. Its area is 400 ft. × 350 ft.

Lottery (P.A. 301).—It is 3 miles north-west of the McPhail. Its area is 10 ac.

Orion's Belt (P.A. 260).—This is 4 miles west of Hart's Camp. Its area is 10 ac.

Frances (Extended M.C. 251).—This is at the Florence Waterhole. Its area is 400 ft. × 350 ft.

United (Extended M.C. 369).—Florence. Its area is 600 × 350 ft.

Better Luck (M.L. 580).—Florence. Its area is 9 ac.

Our Luck (M.C. 125).—Florence River. Its area is 200 × 350 ft.

Myall King (Extended M.C. 243).—Florence. Its area is 400 ft. × 350 ft.

Eclipse (M.C. 236).—Florence. Its area is 800 ft. × 350 ft.

Lady May (Extended M.C. 285).—Florence. Its area is 800 ft. × 350 ft. Output: 1906—7 tons.

Theresa (M.C. 271).—Florence. Its area is 200 ft. × 350 ft.

Juno (Extended M.C. 274).—Florence. Its area is 800 ft. × 350 ft.

Queen Cross (M.C. 260).—Florence. Its area is 1,600 ft. × 350 ft.

Vivian (M.C. 259).—Florence. Its area is 1,600 ft. × 350 ft.

Gem (M.C. 344).—Florence. Its area is 400 ft. × 350 ft. Output: 1906—3$\frac{12}{20}$ tons.

Mount Flannagan (Extended M.C. 269).—This is 1 mile south of the Native Police Waterhole on the Florence River. The area is 1,600 ft. × 350 ft.

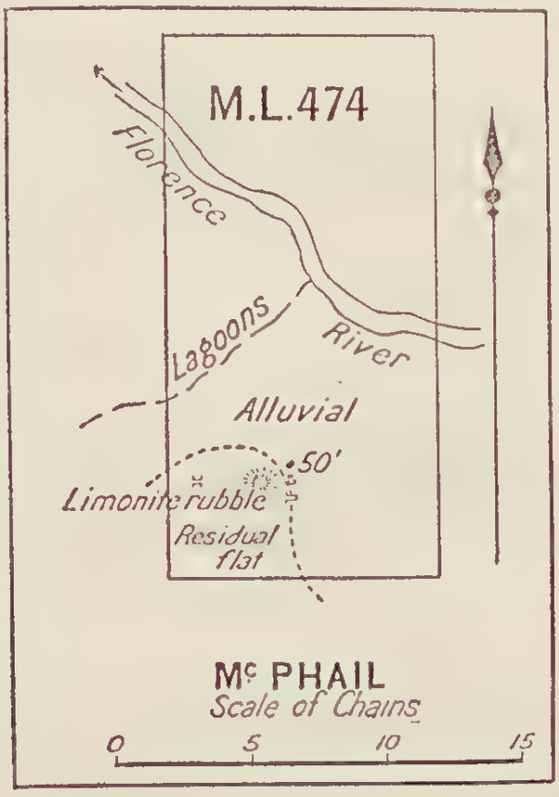
McPhail (M.L. 474).

Mgr., Brady.

Location, Area, Etc.

The McPhail is located on the Florence River, $\frac{1}{2}$ mile west of the main Hampden road, and 33 miles south from Cloncurry.

Its area is 20 ac. This ground was first secured by a prospector named McPhail in 1884—as the Ironclad gold-mining lease. When visited, the present lease had just been placed under option to the Mount Elliott Company. From Press notices it is learnt that the property



was taken over by the Company, in April of this year, a good body of high grade sulphide ore having been proved since my inspection.

The Florence River crosses the McPhail lease, and the greater part of which is consequently low-lying alluvium.

Development.

Very little work was done here till the present holders marked out the lease, and their workings, when inspected, were all in a flooded state, owing to late rains. They are all in the southern part

of the lease, and comprise three trenches and a shaft. The southern trench, 3 ch. from the southern boundary is 30 ft. long, and at the eastern end is 8 ft. deep. Another trench, 40 ft. to the north, has two short branches, one to the east, 6 ft. deep, and one to the north, 16 ft. deep. The shaft, 30 ft. to the north of this trench, is 50 ft. deep. The western trench is 3 ch. west of the central trench.

Output.

		2	tons	shipped,	carrying	33%	copper	(*fide*	Mr.	Brady)
1906	...	7	,,	,,	,,	24½%	,,	(,,	,,	)
Total		9	,,	,,						

Ore-bodies.

In the south-western corner of the lease a mound of strongly ironstained quartzite and schist, 1 ch. in diameter, rises 15 ft. above the flat. It is on the eastern side of this mound, 1 ch. from the summit, that the main workings lie; but a trench on the rubble flat, 3 ch. to the west of the latter, opened on a patch of "copper weeds" (*polycarpæa*), exposes very promising cupriferous gossan veins with spheres of chrysocolla and malachite. There is consequently a possibility of bunches of ore occuring throughout the intermediate ground, the surface of which is covered with limonite rubble, and this should be borne in mind when sinking is undertaken together with exploratory cross-cutting.

There can have been little outcrop of ore, it being mostly hidden by alluvium, and for the same reason nothing has been proved as to the extent of the deposit, though there is a rumour of the crop having been seen in the river bed.

In the southern cut layers of gossan dipping flatly to the east can be seen, and from the hole at the eastern end of the cut green-stained gossan, containing some pockets of acicular malachite, was raised.

The northern trench exposes a body, 2 ft. 6 in. wide, of malachite-bearing gossan (10% copper), which is flat in the northern arm, but dips steeply to the east in the eastern arm. Gossan occurs beneath this body, and limonite with radiating malachite, and chrysocolla was reported at 16 ft. beneath the surface, but, of course, could not be seen by me because of water. In April, 1906, 7 tons of 24½% ore were despatched from here. Besides this there are 15 tons of seconds (15% copper) at grass, consisting of gossan with veins and bunches of malachite and chrysocolla. (Fig. 6.)

The shaft is said to have been sunk, except for one small block of bleached slate, wholly in ore. That from the upper part consists chiefly of limonite, veined with malachite and chrysocolla, and may carry 10% copper. There is 10 tons of it at grass. At 22 ft. depth

an 18-in. seam of richer ore, 2 tons of which yielded 33% copper, is said to have been cut. About ½ cwt. of this ore at the brace consists of chalcopyrite altering into limonite and in parts almost completely replaced by chalcocite. The ore shown me as from the shaft bottom is limonite with disseminated malachite and small bunches of glance.

FIG. 6 (NATURAL SIZE).—OXIDISED ORE, M'PHAIL.

1. Limonite.
2. Crystalline malachite
3. Light earthy malachite
4. Chrysocolla (encrusting)
5. Tile ore.

The whole tip at the shaft will probably run over 5% copper, and it contains very little quartz and quartzite. The absence of quartz from the ore paddocks and the high iron contents are conspicuous features at this mine, pointing to the occurrence of dense pyritic ores at a depth.

In connection with the flooded state of the shaft, it is asserted by the lease-holders that the water in the shaft is not affected by the river, although the latter is only a few chains distant, and its bed is but 15 ft. below the brace.

This property would be worthy of development even if there were only the rich bodies cut in the middle trench and in the northern shaft. The gossans here are soft and not likely to make noticeable crops at the surface, wherefore the bodies may yet be proved to have a considerable north and south extension.

Trump (Extd. M.C. 368).

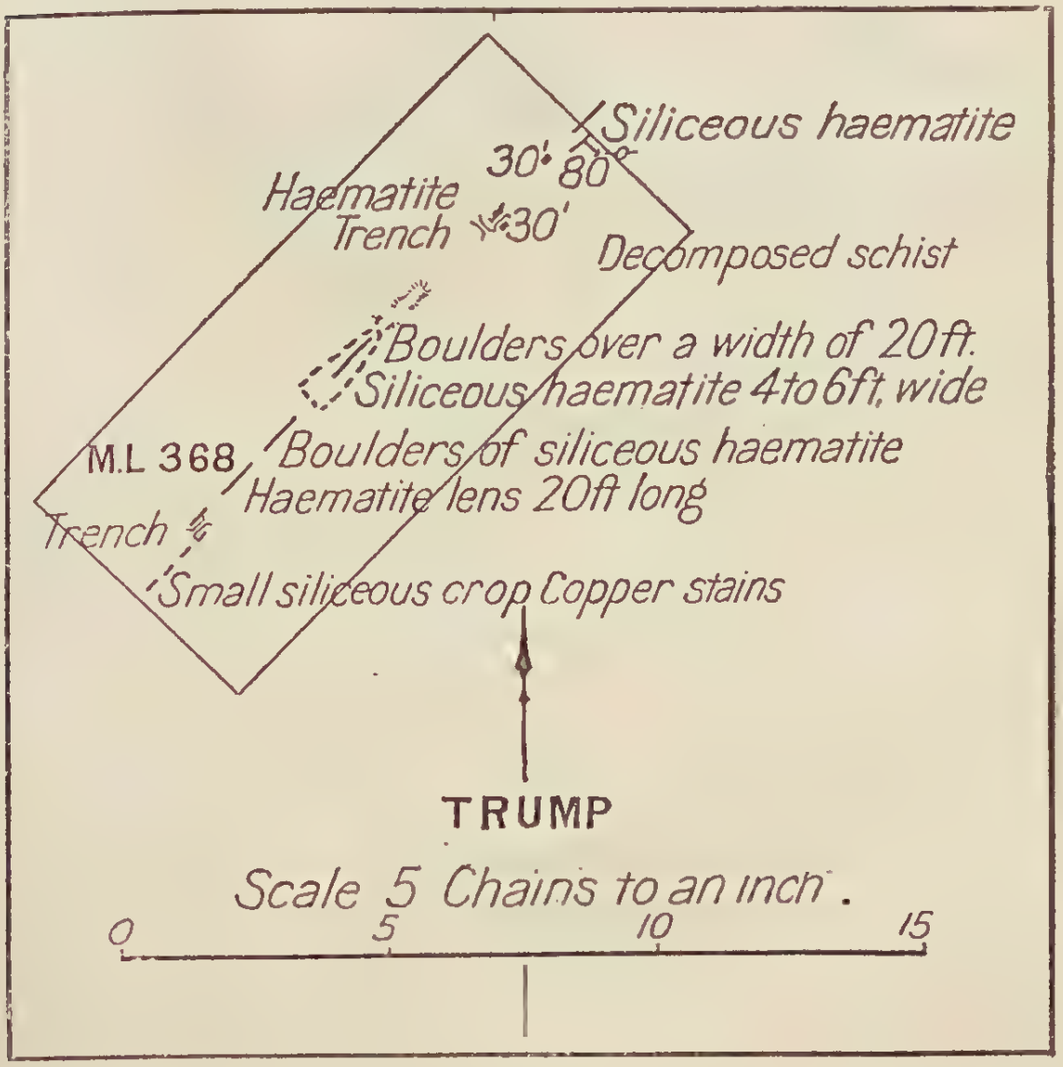
Mgr., McBride.

Location, Area, Etc.

The Trump is about 2 miles south-east of the McPhail.
Its area is 800 ft. × 350 ft.

Development.

The workings comprise three trenches and two shafts. The northern trench, 1 ch. from the northern boundary, is 20 ft. long and 6 ft. deep; and a costean just to the south is 10 ft. long. The southern trench is 2 ch. from the southern boundary.



The northern shaft, 1 ch. south of the northern boundary, is 30 ft. deep.

The second shaft, 15 ft. east of the northern trench, is 30 ft. deep.

Output.

3 tons shipped, carrying 38½ %

Ore-bodies.

The general strike of the ore-bodies here is north-east, and the dip, which is almost vertical, is to the south-east. The outcrops comprise detached lens-shaped masses of siliceous turgite* (sp. gr., 4·2) from 10 ft. to 2 ch. long and 1 to 6 ft. wide. The best of the copper ore is found between and alongside these outcrops, though a little chrysocolla occurs in some of the turgite.

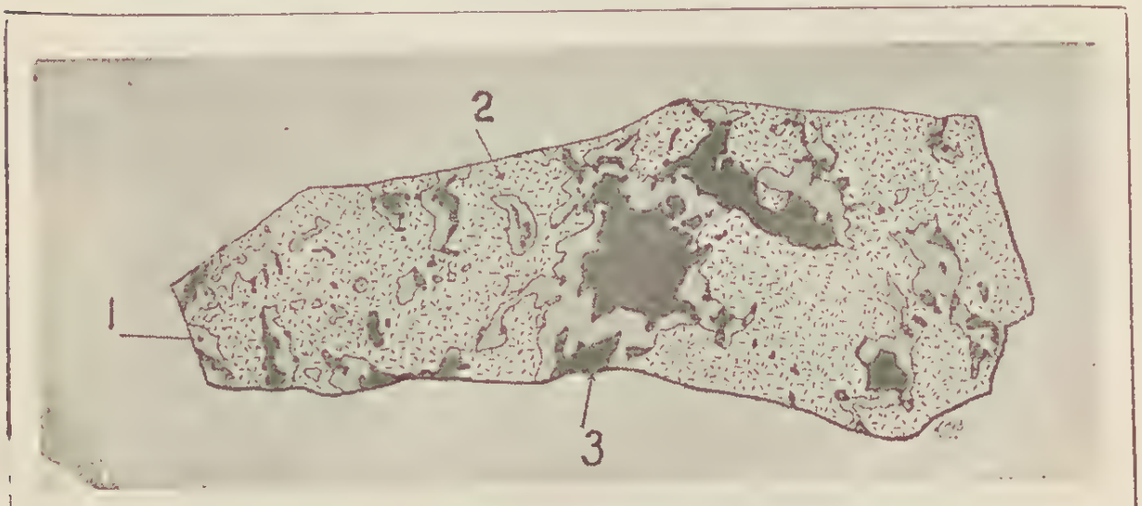


Fig. 7 (double natural size).—Oxidised ore, Trump.

1. Chrysocolla
2. Crystalline malachite
3. Dense limonite.

Crossing the northern boundary there is a crop of siliceous turgite a chain in length.

The northern shaft was sunk in decomposed schist, the footwall country of a body of copper ore at least 2 ft. 6 in. wide. The bulk of this ore is reddish limonite with disseminated malachite and veins of both malachite and chrysocolla (*see* Fig. 7); but along the footwall, which is not well defined, occur boulders of rich ore, consisting of fine grained glance, malachite, chrysocolla, and dioptase, with bunches of pyrite (*see* Fig. 8). Of the lower grade ore about 6 tons at grass may run 15%, while the richer, of which only ½ ton is paddocked, may yield 35% copper.

The northern trench exposes gossan, on the south-eastern side of a crop of turgite 5 ft. wide, which, in the costean, is seen to pinch to 12 in.

At the southern shaft there is at grass about 1 ton of earthy malachite, which will probably run 25% copper, and 3 tons of 38½% ore has been despatched from here.

At 1½ ch. south-west of these workings boulders of iron stone are scattered over a width of 20 ft., for a distance of 1 ch., and 12 ft.

* On the attached plan read "turgite" for "hæmatite."

beyond a big crop of siliceous turgite and jasperoid commences. This projects like a wall, 4 to 6 ft. wide, for 2 ch., but towards the south-west, where much silicified limonite (yellow jasperoid) prevails, lode material is found over a width of 40 ft.

Beyond this crop there is a blank of 20 ft., and then boulders of siliceous turgite appear at the surface for 1 ch.; indurated slaty country then shows for 10 ft., when another blow of impure siliceous turgite 1 ch. long is to be seen. At ½ ch. beyond this there is another crop of turgite 20 ft. long and up to 10 ft. wide.

FIG. 8 (DOUBLE NATURAL SIZE).—RICH OXIDISED ORE, NORTH SHAFT, TRUMP.

1. Pyrite veined with limonite
2. Fine grained malachite
3. Crystalline glance
4. Limonite.

The southern trench, alongside this blow on the east, exposes a small bunch of earthy carbonate ore. Another siliceous slightly copper-stained crop is visible just to the east of this trench, and can be followed for 2½ ch. to the south-west.

GEOLOGY.

This is not a fissure lode, but the ore-bodies presumably occur in a crush zone formed during the metamorphism of the whole region as the occurence of the turgite indicates. The copper ores and turgite have no connection beyond that they have both accumulated in a weak zone, and the turgite is therefore not to be expected to change in depth into sulphides. The ore bodies, however, seem to have a

lenticular shape and to alternate, but the copper would seem to have been introduced subsequently to the iron masses—for it is found only between and alongside those masses.

Talk o' the Hills (Extended M.C. 333).

Mgr., Pearson.

Location, Area, Etc.

This lies 5 miles south-east of Hart's Camp, Florence, and ¾ mile north-east of the Trump.

Its area is 200 ft. × 350 ft.

Output.

1906 ... 1 ton shipped.

Ore-body.

There is reported to be here a small leader of very rich ore and 4 ft. poor red ore, similar to that at the Trump (*i.e.*, turgite), on the line of which this claim is believed to lie.

Dandy (P.A. 297).

Mgr., Jackson.

Location, Area, Etc.

The Dandy is ¾ mile west-south-west of the Trump, and 2 miles south of the Florence River.

Its area is 10 ac.

One shaft 35 ft. deep has been sunk.

Output.

1906 ... 6$\frac{10}{20}$ tons, 40% ?

Ore Deposits.

The original cupriferous crop was only a few square feet in area, and only silicified limonite can now be seen at the surface, but even of this there is very little. The strike of the body appears to be north-east or north-east-by-east, though there is a small crop some yards to the east-north-east. A separate lens of silicified limonite crops 1 ch. to the north-west of the shaft.

The shaft was sunk in crystalline granular limestone and hæmatite with irregular bodies of copper ore, more especially near the hanging-wall slate, into which they gradually fade. Near the surface the

ore (*see* Fig. 9) consisted of siliceous limonite, malachite, chrysocolla (a sky-blue variety, perhaps cyanochalcite), and dense chalcocite, and, together with granular limestone (carrying cuprite) made a body 4 ft. wide. At 6 ft. from the shaft bottom cuprite is associated with ferro-calcite, limonite, and calcite; and the calcite at the bottom carries both cuprite and native copper over a width of 4 ft. The

FIGS. 9 AND 10 (NATURAL SIZE).—OXIDISED ORE, DANDY.

1. Fine grained malachite
2. Cyanochalcite
3. Limonite.

1. Calcite
2. Cuprite
3. Native copper.

native copper occurs dotted through the ore as small jagged particles (not visibly crystalline), and is always surrounded by cuprite (*see* Fig. 10). There are about 3 tons of silicate ore at grass, which may be expected to carry 10% copper; and 4 tons of the limestone ore (ferro-calcite with nearly one-half cuprite and veins of limonite), probably containing over 40% copper.

Erin-go-bragh (Extended M.C. 372).

Mgr., Riordan.

LOCATION, AREA, ETC.

This, formerly known as the Alma, lies ½ mile east of the Hampden road, 2 miles north of the Florence River, and 31 miles south of the Cloncurry.

Its area is 800 ft. (?) × 350 ft.

There is one shaft 45 ft. deep.

ORE-BODY.

Unfortunately this claim was not visited, but one of the leaseholders informed me he had a body of silvery glance, 15 in. wide, in

the shaft, and that 10 tons of the ore, estimated to carry 45% copper, lay at grass. A specimen of the ore given me consists of almost pure chalcocite, there being only minute specks of the original chalcopyrite and traces of the limonite formed by its oxidation. Stains of malachite and azurite on open cracks are due to recent oxidation of the chalcocite.

OUTPUT.

1905	...	20	tons shipped,* 40% ore
1906	...	$6\frac{15}{20}$	,, ,,
Total	...	$26\frac{15}{20}$	,, ,,

* Claim then known as the Alma.

MALBON RIVER.

Of the Malbon River groups only the Just-in-Time, on the lower Malbon, was visited. The groups at the head of the river were not visited because of their being deserted during my stay.

The Eastern Malbon is really on a continuation of the Duck Creek belt, the lodes all having an east and west trend. At the Malbon, however, though the outcrops seem to all mark lines of crushing, more persistent perhaps than at Duck Creek, the ore bodies are more limited in size.

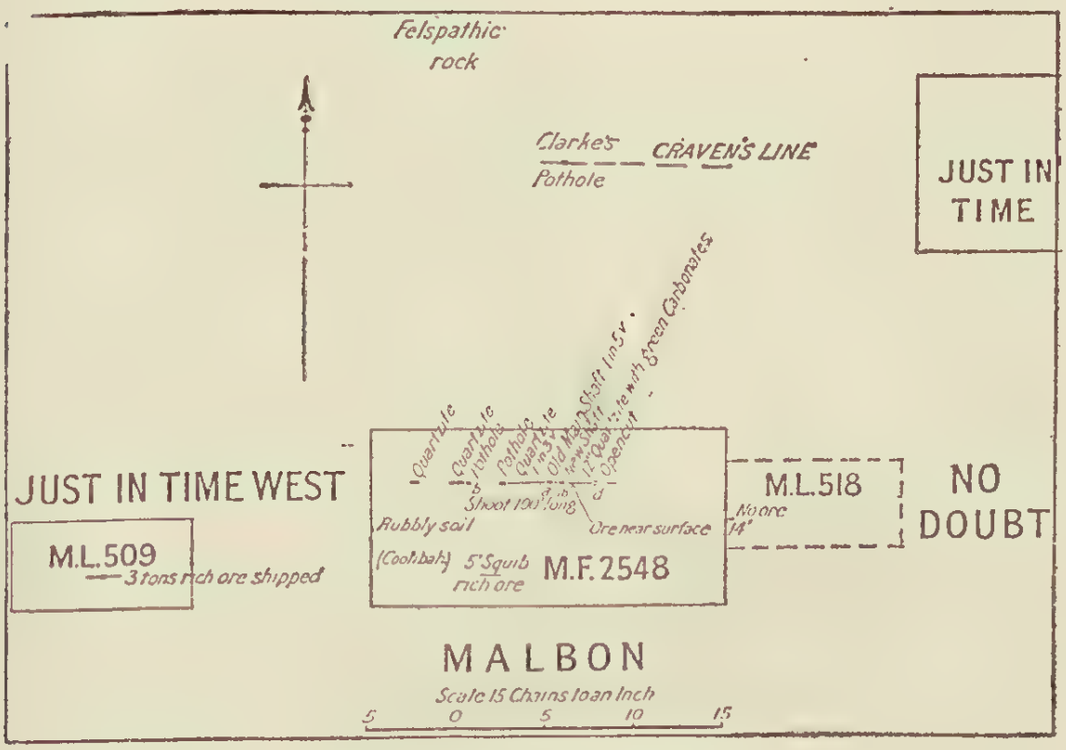
The country is flat, with reddish, sandy soil, or is very slightly rolling, and is then rather gravelly. The only timber is stunted gidia and coolibah (or desert gum).

Output.

The total amount of ore shipped between the beginning of 1901 and the end of 1906 is, according to the available records, 864 tons.

JUST-IN-TIME GROUP.

The Just-in-Time Group is situated on the Malbon River, about 5½ miles above its junction with the Cloncurry River.



Malbon (M.F. 2548).

Location, Area, Etc.

This freehold lies 30 miles south-south-west of Cloncurry, about a mile south of the Malbon River and a mile west of the Devoncourt road. It is often called the Just-in-Time, and is so shown on the map.*

* G.S.Q. Publication No. 213.

Its area is 20 ac. When inspected, the freehold was the property of Messrs. Coats and Robertson, but it has since passed into the hands of the Queensland Copper Freeholds, Ltd.

Literature.

For title of report numbered as below, see Introduction.

(7) Mr. Rutherford concludes thus:

"This, then, is an irregular deposit of rich copper glance. . . . I believe that this mine will yield up to 100 tons of rich ore similar to that already extracted."

Development.

The workings include costeaning trenches, two opencuts, two potholes, and two shafts.*

The larger opencut, lying 2½ ch. east of the old main shaft, is 27 ft. long and perhaps 20 ft. deep, but has now fallen in and is flooded below 6 ft.; the other, 30 ft. long and 10 ft. deep, is on the western side of the old main shaft.

The two potholes are 2½ and 4½ ch. west of the old main shaft.

The old main shaft, 3 ch. from the northern boundary and half-way between the eastern and western boundaries, was 27 ft. deep when abandoned, but is now filled in to within a few feet of the surface.

The new main shaft is 40 ft. to the east of the old. It is on the site of an old filled-in shaft, and is now 18 ft. deep. Sinking was being carried on here for the owners by two miners in December, 1906.

Output.

		98	tons shipped by Craven
1901	...	33	tons, 37%
1903	...	33	,,
1905	...	29 19/20	,,
Total	...	193 19/20	,,

Ore Deposits.

The outcrop can be traced, with two breaks, over a distance of 12 ch. Of this, however, only 7 ch. has been proved to be richly cupriferous. The crop runs east and west in indurated slate country, covered by loose rubbly soil in the western part and by alluvium in the eastern.

In the western end of the eastern open-cut can be seen a formation 6 ft. wide, one-third of which is country rock and the remainder high grade carbonate ore. In the eastern end of the cut the formation has pinched to 12 in., and the grade is probably not above 10% copper.†

* The manager reports (May, 1907):—"No. 1 shaft sunk 42 ft.; opencut cleared to a depth varying from 8 to 22 ft."

† The manager found on cleaning out the cut in May, 1907, that the ore varies in width from 1 in. to 4 ft.

The deposit here seems to make a bend towards the east-north-east, and the old trenches to the east consequently revealed nothing.*

The crop west of the cut comprises 12 in. width of quartzite, with malachite.

At the new main shaft the body increases to 2 ft. in width just beneath the surface.†

In the stope east of the old main shaft, at 6 ft. beneath the surface, the ore-body, consisting of a high-grade mixture of malachite and tile ore, is 18 in. thick, but, within a few feet, it increases to 2 ft. 6 in. The footwall here is dipping 5 in 1 h. to the south, is well defined, and is slickensided vertically, and some pug occurs along it. At 22 ft. depth in the shaft, where the dip is steeper than above, it has been reported that there is 4 ft. width of red oxide of copper, and three parcels totalling 32 tons, from a drive at that level, yielded respectively 46%, 48% and 49% copper.

The open cut to the south of this shaft exposed a formation, 18 in. to 2 ft. 6 in. wide, formed of slate replaced to a greater or less extent by malachite, tile ore, and chalcocite. The dip here is 1 in 3 v. to the south.

About 10 ft. west of the open cut quartzite appears and can be followed to the eastern pothole, but there is no crop between that and the western pothole, in which is to be seen 5 ft. width of quartz, quartzite, and silicified slate, stained by malachite, but on the whole very poor in copper. West of this hole there are two crops of quartzite, 1 ch. and ½ ch. in length and separated by a 1½ ch. blank.

Much rich ore is understood to have been shipped from here before the ground was proved to be freehold, and some is stated to have disappeared since. The seconds at grass, amounting to 5 tons, consist of limonite, malachite, and tile ore, and they may run 10% copper; the 3 tons of thirds are very siliceous (70% SiO_2) and probably do contain more than 5% copper.‡

Just-in-Time West (M.L. 509).

Mgr., Craven.

Location, Area, Etc.

This lies 10 ch. (?) west of the Malbon freehold.

Its area is 5 ac. Exempt and idle.

The shaft lies 15 ch. west of the Malbon freehold.

Output.

3 tons of rich ore have been shipped.

---

* The manager reports for May, 1907 :—"No. 2 shaft has not yet started, owing to the lode having been faulted 21 ft. east of open cut; sinking a prospecting shaft there."

† This is probably that referred to as shaft No. 1 in the manager's report for May, 1907 :—"The average width of the lode (to 42 ft.) is 3 ft., the average value of the ore 33% copper; the last 15 ft. of the sinking average ore width 4 ft. 2 in., 34% copper."

‡ The manager reports (June, 1907):—"There are 80 tons of ore in dump, with, say, 30 % copper."

No Doubt (M.L. 518).

Mgr., Allman.

LOCATION, AREA, ETC.

The No Doubt adjoins the Malbon freehold on the east.

Its area is 5 ac. Deserted.

There is one shaft, 14 ft. deep, on the Malbon freehold boundary and 2 ch. south of the freehold line of workings.

No ore-bodies have been exposed.

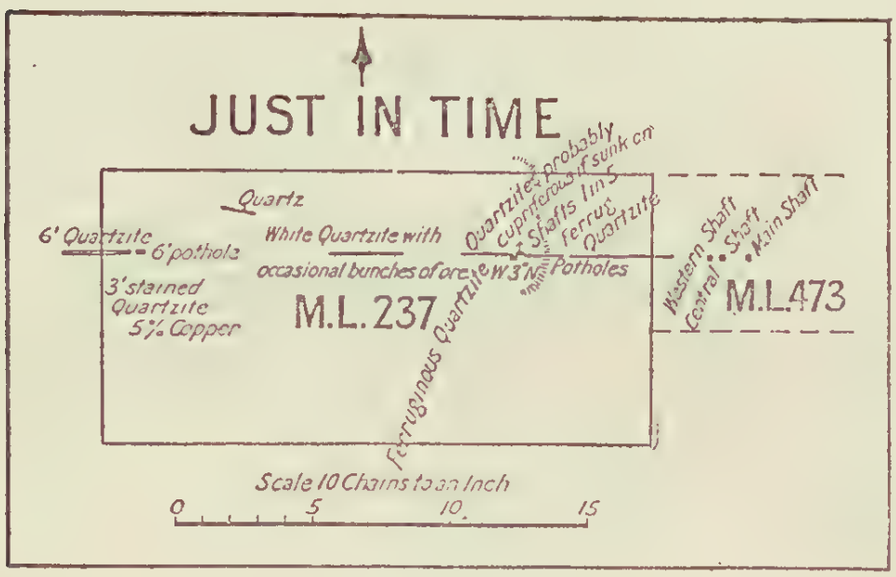
Just-in-Time (M.L. 237).

Mgr., Craven.

LOCATION, AREA, ETC.

The Just-in-Time is about ¼ mile north-east of the Malbon freehold.

Its area is 20 ac. Exempt and idle when visited in December.



DEVELOPMENT.

There is a shallow pothole near the western boundary, but the main workings are in the north-eastern part of the lease. These comprise two shafts, 20 ft. deep, sunk with adjacent corners only 2 ft. apart. Both are now inaccessible, but from the surface a stope 10 ft. wide can be seen, on the southern side of the eastern shaft, and also a 15 ft. drive running westwards from the western shaft, at 15 ft. below the surface.

LITERATURE.

For title of report, numbered as below, see Introduction.

(8) Mr. Gibb has tabulated the following analyses (Government Analyst):—

	(c) Country rock.	(r) Rejected from ore raised.
Cu	nil	25·1
SiO_2	57·1	34·2
F_2O_3	13·7	18·1
Al_2O_3	14·4	1·4
CaO	...	trace
S	...	...
	85·2	98·8

OUTPUT.

1901	12 tons	(Freehold?)	shipped, carrying 37·3% copper
1903	33 ,,	(whole Malbon?)	,,
1904	36 ,,		,,
1906	21 ,,	(Craven and party?)	,,
	8 ,,		
Total	110 ,,		,,

ORE-BODIES.

Quartzite crops both east and west of the shafts, ironstained but barren in the former case, but containing some bunches of ore for 20 ft. in the latter. At 1 ch. west of the shafts the quartzite becomes very ferruginous, and at 2 ch. distance is worth sinking on in search of copper ore. The body then appears to pinch almost out for two or three chains, beyond which white quartzite with occasional bunches of ore crops out.

On the western boundary there is a quartz blow, 6 ft. wide, at the eastern extremity of which the pothole reveals quartzite stained on cracks with malachite and a little tile-ore, over a width of 3 ft., but containing not more than 5% copper.

The quartzites are reported to crop intermittently for miles to the west.

The north-eastern shaft was sunk on the hanging-wall side (the dip being 5 in 1 to the north), and the south-eastern on the footwall side, of a formation of quartz-veined crushed schist, in which occurred bunches of rich ore. There is about 1 ton of the unsorted ore at grass, chiefly a fine-grained and intimate mixture of malachite, chalcocite, and limonite, with patches of gossany tile-ore; also 3 tons of firsts, which contain, say, 10% silica and probably 35% copper; and 10 tons of very siliceous seconds. Analyses of ore from here are given under Literature. Viewed from the surface this body appears to be worth further opening up.

Development both east and west of this lease would seem to indicate that the ore-bodies on the Just-in-Time line are isolated and of no great size.

Just-in-Time, No. 1 East (M.L. 473).

Mgr., Corney.

Location, Area, Etc.

This adjoins the Just-in-Time lease on the east.

Its area is 10 ac. Exempt and idle. It was last held by the Cloncurry Prospecting Syndicate.

Development.

The workings, three shafts, lie about 7 ch. east of the Just-in-Time shafts. The western shaft is 15 ft. deep, was sunk in 1903, and some stoping has been done from it. The central shaft, 56 ft. deep, with drive 40 ft. east at the bottom, is 3 ch. to the east of the western, and the main, or eastern shaft, about 50 ft. deep, is 1 ch. beyond.

Output.

1905	...	9 tons shipped, carrying 40% copper
1906	...	20 tons ,,
Total		29 ,,

Ore-bodies.

The western shaft is in quartzose schist, lenticular bodies of which have been found to be cupriferous.

The central shaft was sunk in similar country. Little ore was got above 53 ft., but in the bottom of the shaft and in the eastern drive there is understood to be a lode, averaging 3 ft. in width, of silver-grey ore, passing downwards into black sulphides. A specimen of the ore given me has a ground mass of chalcocite, through which are distributed very numerous spangles and irregular grains of chalcopyrite, all of which are, however, minutely reticulated by chalcocite. The specimen has one inclusion of pyrite partly altered to limonite, separated from the secondary ore by a thin band of quartz. Fine-grained acicular malachite occurs on cracks in the specimen.

Just-in-Time, No. 2 East (M.L. 388).

Mgr., Craven.

Location, Area, Etc.

This adjoins the No. 1 East on the east.

Its area is 5 ac. Deserted.

Output.

1906 ... 10 tons shipped.

Clarke's (M.C. ?).

Location, Etc.

Clarke's Claim is 15 ch. north of the Malbon freehold and ¼ mile west of the Just-in-Time lease. It was deserted and apparently abandoned in December last.

One shaft has been sunk 15 ft.

Output.

1 ton shipped.

Ore-body.

The shaft was sunk on a bunch of ore in quartzite and crushed schist. Malachite occurs over a width of 6 ft., but the average will not exceed 5%.

The seconds at grass, 3 tons, contain carbonate and oxide, and may run 15% copper, but are very siliceous.

The country to the north-west is felspathic rock, possibly an altered porphyry.

Literature.

For title of report, numbered as below, see Introduction.

(8) The following analyses (Government Analyst) are given in Mr. Gibbs's report:—

(c) Country rock—

Copper	= nil.
Silica	= 57·1
Iron protoxide ...	= 13·7
Alumina	= 14·4
	85·2

(r) Rejected from ore raised—

Copper	= 25·1
Silica	= 34·2
Iron protoxide ...	= 18·1
Alumina	= 1·4
Lime	= tr.
	78·8

Adelaide (M.L. 549).

Mgr., Nathan.

Location, Area, Etc.

The Adelaide is ¼ mile north of the Just-in-Time lease.

The area is 10 ac. Abandoned.

Development.

The workings comprise only potholes, trenches, and open cuts. Going from the eastern boundary they are: at 1 ch. an old trench, 40 ft. long, fallen in; after 1½ ch., a trench, 15 ft. long and 6 ft. deep in 12 ft., a pothole, 6 ft. deep; in 10 ft., an open cut, 30 ft. long, 10 ft. wide, and 20 ft. deep, and a 2-ft. trench continued 40 ft. to the east; in 1 ch., a trench, 20 ft. long and 2 to 4 ft. deep; and in ½ ch. a costean.

Ore-body.

The ore from the second trench from the east is quartz-veined but carries limonite and malachite, and the contents will run from 10 to 15% copper.

Near the surface, in the open cut, a 2 ft. 6 in. formation, dipping 80° to the south, is exposed, and there is said to be 18 in. solid ore in the bottom beneath the earth fallen in. The manager in December, 1905, reported a lode, 1 ft. to 2 ft. 6 in. wide, of silver-grey ore, assaying 40 to 50%, and the Warden in March, 1906, saw 2 ft. of solid rich ore in the bottom of the cut, 30 ft. from the surface.

In the trench to the west of the open cut there is very siliceous malachite and tile ore, likely to yield 20% copper.

OUTPUT.

1904	...	18	tons shipped		
1905	...	$7\frac{19}{20}$	,, ,,	carrying	32% copper
1906	...	3	,, ,,	,,	35% ,,
		8	,, stacked		
Total		$36\frac{19}{20}$	tons		

Wheeler's shaft, 25 ft. deep, was sunk about 4 ch. east of the above lease. The prospector got 3 tons of rich red oxide, in a trench at the surface, but little or no ore has been raised from the shaft.

Tower's Boys (Extended M.C. 261).

Mgr., Miller.

LOCATION, AREA, ETC.

This lies about 10 ch. east of the Adelaide.

Its area is 1,200 ft. × 350 ft. Abandoned (?)

One shaft is 50 ft. deep, with drives east and west respectively 10 ft. and 12 ft. long.

ORE-BODY.

The material on the tip is quartz-veined schist, with replacements of tile ore, and stains of green carbonates, but none of it is quite payable.

Telegraph (M.L. 222).

Mgr., Craven.

LOCATION, AREA, ETC.

The Telegraph lies $2\frac{1}{2}$ miles north of the Just-in-Time lease, within $\frac{1}{2}$ mile west of the Boulia road.

Its area is 10 ac. It has been exempt for many months.

It was worked during 1902, 1903, 1904, and 1905, but, being deserted, was not inspected by me.

ORE-BODY.

The ore-body is understood to run east by north.

OUTPUT.

1902	...	18	tons	shipped
1904	...	5	tons	,,
1905	...	8	,, (Wheeler)	,,
		$8\frac{19}{20}$	,, (Craven)	,,
Total		$39\frac{19}{20}$	,,	

LIMESTONE CREEK GROUP.

This group is on one of the northern tributaries of the river, midway between the Duck Creek and Corella River Groups.

Huggins Look-Out (M.L. 248).

Mgr., Matheson.

LOCATION, ETC.

Huggins Look-out is located on Limestone Creek, an affluent of the Malbon, 30½ miles south-west of Cloncurry.

Its area is 15 ac. The lease is held by the Willcocks Cloncurry Development Syndicate.

The surveyor's plan indicates workings in the northern part of this lease.

ORE-BODIES.

Mr. Cherry, the Warden, in December, 1903, reported that:—"There are three noticeable outcrops. The formation appears to consist largely of a kind of limestone." In February, 1905, he added:—"There appears to be a considerable quantity of ore available of good smelting quality, low grade. . ."

Huggins Look-in (M.L. 249).

Mgr., Matheson.

LOCATION, ETC.

Huggins Look-in is situated 10 ch. east of Huggins Look-out.

Its area is 15 ac. The lease is the property of the Willcocks Development Company.

Two shafts are shown on the surveyor's plan, one near the centre of the northern boundary and the other 4 ch. to the south-west. The company has not reported any work done.

ORE-BODIES.

The survey plan shows outcrops striking north-east in the northern and western part of the lease.

PINDORA GROUP.

The Pindora is the most easterly of the groups at the head of the Malbon.

Pindora (M.L. 295).

Mgr., Donner.

LOCATION, ETC.

The Pindora lies south of the Malbon River, 39 miles south-west-by-west from Cloncurry.

Its area is 10 ac.

ORE-BODIES.

The survey plan shows a quartz crop striking north-east.

Pindora South (M.L. 296).

Mgr., Donner.

Location, Etc.

The Pindora South lies ½ mile south of the Pindora.

Its area is 10 ac.

One shaft is located in the south-western corner of the ground.

Ore-bodies.

The surveyor's plan shows an outcrop running north-north-east, along the western side of the lease.

Bevan Consols (M.L. 519).

Mgr., Bevan.

Location, Etc.

The Bevan Consols is understood to lie 2 miles south of the Pindora.

Its area is $9\frac{8}{10}$ ac.

MOUNT HOWARD GROUP.

The Mount Howard leases lie to the north-west of the Pindora Group.

Mount Howard (M.L. 569).

Mgr., Williams.

Location, Etc.

Mount Howard is on the northern side of the Malbon River, 40 miles south-west-by-west of Cloncurry.

Its area is 6 ac.

Mount Howard South (M.L. 589).

Mgr., Bevan.

Location, Etc.

This adjoins the Mount Howard on the south.

Its area is 10 ac.

LADY MAUD GROUP.

The Lady Maud lies to the west of the Pindora group. The ground had only lately been secured.

Lady Maud (M.L. 671).

Mgr., Scott.

Location, Etc.

The Lady Maud is on a southern tributary of the Malbon River 4 miles south-west of the Pindora, and 43 miles south-west-by-west from Cloncurry.

Its area is $14\frac{9}{10}$ ac.

Wee Taylor (M.L. 707).

Location, Etc.

The Wee Taylor, 2 miles south of the Lady Maud.

Its area is 5 ac.

Lady Harriett (M.L. 722).

Location, Etc.

The Lady Harriett is located $1\frac{1}{4}$ mile south-west of the Wee Taylor.

Its area is 20 ac.

FOUNTAIN SPRING GROUP.

The Fountain Spring Group is located in the range between the heads of the Corella and Malbon Rivers.

Iron Mask (M.L. 529.)

Mgr., Donner.

Location, Etc.

The Iron Mask lies 42 miles west-south-west of Cloncurry.

Its area is 20 ac. It is understood that this lease is held by the Wee MacGregor Company as a flux area.

Iron Crown (M.L. 530).

Mgr., Donner.

Location, Etc.

The Iron Crown adjoins the Iron Mask on the south.

Its area is 20 ac. The ground is held by the Wee MacGregor Company for flux.

Lady Lenore (M.L. 633).

Mgr., Allis.

Location, Etc.

The Lady Lenore is located on one of the eastern tributaries of the Malbon River, 45 miles west-south-west of Cloncurry. It is shown on the map as on a western tributary.

Its area is 5 ac.

DUCK CREEK.

The ore-bodies worked on Duck Creek, Slaty Creek, and the lower Malbon River occur in crush-zones ("formations,"), striking between east-north-east and east-south-east, all others in the Cloncurry district having a general north and south trend. These zones were produced by the yielding of the country along certain lines under the tectonic forces, which induced the schistosity and metamorphism of the whole region, rendering it impossible to detect the original lines of stratification, or even to distinguish between sedimentary and igneous rocks, without microscopical examination.

Many of the quartz crops were at first mistaken for altered sandstones, but my opinion is now that, with few, if any, exceptions, the quartz either segregated from the schists during their metamorphism or has been subsequently introduced.

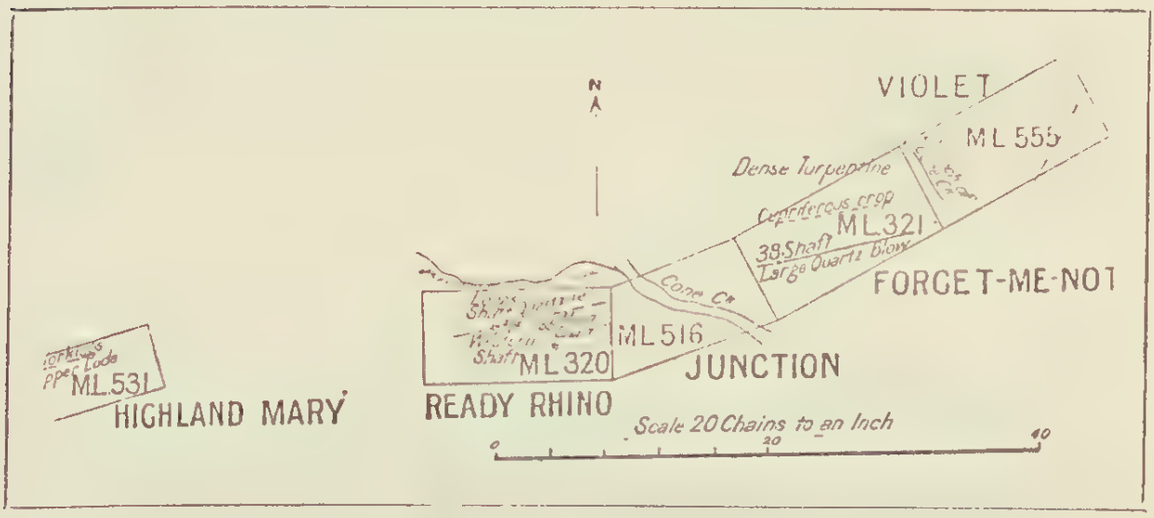
The occurrence of the copper ores is so irregular, and the formations are so variable in width, even within limited areas, that it will

be impossible to make any justifiable estimate of the ore available above any level in any of the mines until it has been completely blocked out.

For purposes of location reference is generally made below to the blast furnace on Mount Start at the junction of Cone and Duck Creeks, 23½ miles south-west by west from Cloncurry.

READY RHINO GROUP.

The Ready Rhino group proper includes only the Ready Rhino, Junction, Forget-Me-Not and Violet—the Highland Mary, Coronet and



White Rose occurring really on separate crush-zones, and being here included simply because of their geographical position. The last two differ from others on Duck Creek in dipping northwards.

Highland Mary (M.L. 531).

Mgr., Wallace.

Location, Etc.

The Highland Mary lies ¼ mile west of the Ready Rhino, 2¾ miles north-west-by-north of the blast furnace on Mount Start, and 5 ch. south of the Gorge-Corella road.

Its area is 5 ac. The ground was deserted during my stay in the locality.

Development.

The workings comprise three open-cuts, 1 ch. from, and about half-way along, the northern boundary. The western cut is 18 ft. long and 8 ft. deep; the central, 6 ft. to the east, is 8 ft. long and 6 ft. deep; and the eastern is 12 ft. long and 15 ft. deep. No work had been done since the rain which had fallen two months previously, and the cuts were therefore in a state of collapse. The latest proposal is to sink a shaft to the west of the cuts.

Output.

1904	...	4	tons	shipped	by Wallis, carrying 30% copper
1906	...	3	,,	,,	from the Highland Mary
		10	,,	,,	by Wallace, reported to carry 37 to 39 % copper*
Total	...	17	,,	,,	
		$\frac{1}{20}$	,,	at grass	(firsts)
		10	,,	,,	(seconds).

Ore-body.

The country here is very flat, and the red soil surface is strewn with quartz fragments, but the Highland Mary ore-body made practically no crop, unlike the Ready Rhino, which passes about 10 ch. to the south. The cuts, however, show the strike to be east 12° north, and the dip 85° to the south-by-east. In the western cut 12 in. width of chrysocolla and gossan is visible, the section between kaolinised slate footwall and granular slate hanging-wall being: gossan and chrysocolla, 12 in.; quartz, 3 in.; and silicified slate, 4 in. In the central cut the lode pinches to 6 in., but in the eastern cut it increases to 15 in. and 18 in. in width, most of which, however, is quartz.

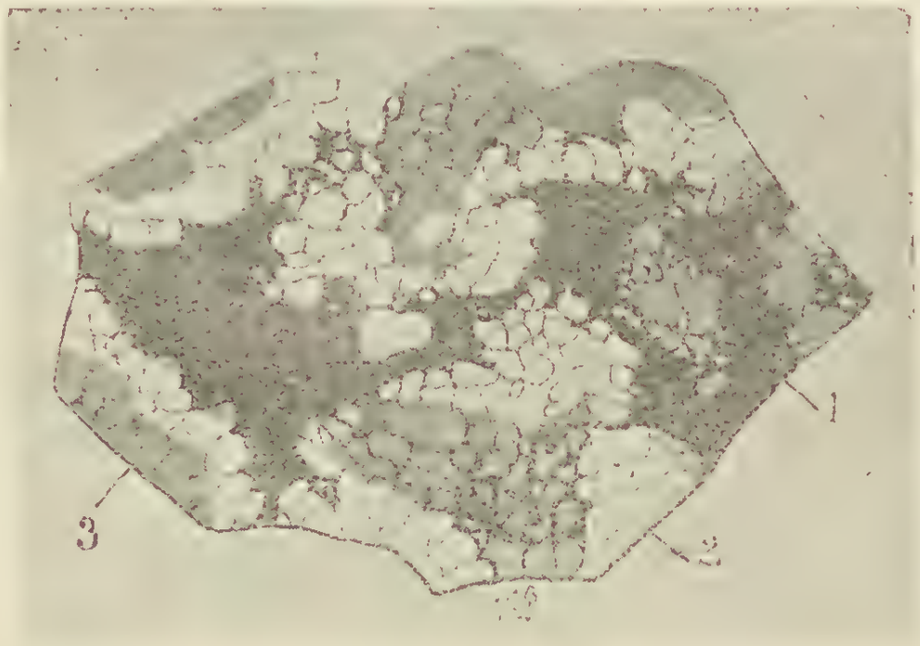


Fig. 11 (natural size).—Oxidised ore, Highland Mary.

1. Earthy turyite.
2. Crypto crystalline malachite.
3. Chrysocolla.

In all, 17 tons of 30 to 39% ore have been shipped from this lease, 1 cwt. at grass being "tesselated ore"—*i.e.*, chalcopyrite in process of alteration into limonite and chalcocite, oxidation having taken place along innumerable intersecting cracks in the original

* The profit on this is stated to have been £22 per ton, above all expenses except mining.

mineral. The seconds at the central cut, bulking 5 tons, consist of quartz and limonite stained by malachite and of black cellular gossan of most promising appearance. The 5 tons seconds at the western cut comprise fragmentary quartz cemented by limonite, and nodules of limonite and earthy turgite with much chrysocolla and malachite, these two minerals in many places fading gradually one into the other. The chrysocolla is typically mammillated in form and, in many parts of the limonite, is also globular. The chrysocolla is more aboundant towards the crust of the nodules, malachite being in excess near the centre, and all stages are exhibited of the replacement of the carbonate by the silicate. Much of the earthy turgite has been porcellanised by deposition of secondary silica and now possesses the same absorptive property as the chrysocolla it encloses. (Fig. 11.)

The state of the workings does not admit of the estimation of available ore, but further development is warranted.

The country rock is more slaty than in most of the Duck Creek mines, having developed only incipient schistosity with comparatively unimportant segregation of quartz. It is greatly weathered and near the ore-body contains much calcareous kaolin. The rock exposed in the western workings may possibly be a highly altered and weathered eruptive. It has a fine micaceous base, in which are set minute crystals of pink orthoclase and lenses of chlorite, the latter thinly coated by granular silica. Amygdaloidal bodies of epidote, surrounded by a thin film of granular silica, are not uncommon and give the rock a volcanic appearance. Similar rock was seen on the Daisy and to the north of the Rainbow freehold.

Ready Rhino (M.L. 320).*

Mgr., Long.

Location, Etc.

The Ready Rhino is located 2½ miles north-north-west of the blast furnace on Mount Start. The main branch of Cone Creek is only 3 ch. to the north-east, and the Gorge-Corella road passes within 10 ch. to the north.

Its area is 10 ac. The lease was being worked by Mr. Jackson for the North Queensland Exploration Company, under an option which extended to December, 1907.

* Shown on plan incorrectly as 520.

Development.

The main shaft, which is in the north-eastern part of the lease, is 55 ft. deep, and crosscuts are being opened north and south.*

A second shaft (Long's), 19 ft. deep, lies 4 ch. to the west-by-south, and a third, 21 ft. deep, 30 ft. beyond it. A crosscut is to be opened north from the last. The manager had 5 men at work here in October.

Output.

1904 ...	4 tons	shipped,	carrying 30 % copper		
	— „	„			
	—				
Total ...	20 „	„	„	27½ % copper (*fide* Mr. Jackson)	
	—				
	9 „	at grass	„	35 %	„
	9 „	„	„	15 %	„
	6 „	„	„	10 %	„

Ore-bodies.

The Ready Rhino outcrop strikes east 10° north, dipping steeply south-south-eastwards, and consists, as usual, of schist and quartz, making, however, comparatively little show at the surface. The schist-quartz crush-zone is 8 yds. wide, and the copper ore is found chiefly in bunches along the foot- and hanging-walls. All the work yet done has been on the latter, but the proposed crosscuts are intended to prove any ore-bodies on the former at a depth. The crop does not appear in the vicinity of the lease to the west, but is in evidence about 10 ch. south of the Highland Mary workings. It has been traced through the Junction and Forget-Me-Not on the east.

The main shaft is in a formation of crushed schist and quartz, cupriferous to a depth of 22 ft., where occurs a parting dipping 45° to the south-east, below which the formation is barren of copper.† There are at grass 9 tons of 35% ore, comprising dense limonite, malachite and glance in kaolinised schist, and 9 tons of 15 % ore (seconds), in which the copper is present chiefly as carbonate and to a less extent as oxide.

Long's shaft exposes a nearly vertical body, 4 ft. wide, of cupriferous kaolinised schist, with lenticular masses of granular quartz. Some 15 or 20 tons of 27½% ore have been shipped from here. The

* The manager reported Jan 29, '07:

"The straight shaft on the Ready Rhino has been sunk to a total depth 80 ft. from the surface. The water is very heavy and labour [consequently] hard to obtain. We have started to open out at 70 ft., which is water level. . . . Since starting to crosscut a distance of 16 ft. has been driven."

† The manager reported (29th Jan. '07) that in the crosscut on the 70 ft. level: "We passed through the lode, which is 3 ft. 6 in. in width. We are now driving on the lode east and west. In the east drive the ore body measures 5 ft. and assays in bulk 9%. In the west drive it is 3 ft. thick and assays 3·25 % copper."

seconds remaining amount to 6 tons and consist of quartz with limonite, malachite and a little chalcocite, the average content being 10% copper.

Junction (M.L. 516).

Mgr., Jackson.

Location, Etc.

The Junction adjoins the Ready Rhino on the east, and is crossed from north-west to south-east by Cone Creek.

Its area is 7 ac. The lease is held by the North Queensland Exploration Company, which had not yet begun operations when it was visited by me.

Forget-Me-Not (M.L. 321).

Mgr., Long.

Location, Etc.

The Forget-Me-Not adjoins the Junction on the east, and lies between the main and eastern branch of Cone Creek.

Its area is 10 ac. The lease is being worked under option by Mr. Jackson for the North Queensland Exploration Company.

Development.

The shaft, which is 2 ch. from the western boundary, has been sunk 38 ft., and a crosscut is now being opened on the southern side. Two men are working here.

Ore-bodies.

The Ready Rhino formation appears on this lease as a large crop, traceable to the eastern boundary, of crushed schist and lenticular masses of quartz, with interstitial bunches of copper ore.

The shaft has been sunk on a copper-bearing band of country on the southern side of the blow. Bunches of copper ore were found to a depth of 20 ft., where was pierced a body of chalcocite, containing quartz crystals, the whole 18 in. thick, and dipping 3 in 1 h. to the south, but below the formation is barren of copper and free from iron. The copper-bearing country is expected to be reached in the southern crosscut within 6 ft.

Another parallel crop, lying 3 ch. to the north, shows 1 to 5 ft. of quartz, with fairly strong iron stains and frequent bunches of

copper ore over the whole length of the lease. In appearance it is more promising than the main crop, but no work has yet been done here.

Violet (M.L. 555).

Mgrs., Long and Jones.

Location, Etc.

The Violet adjoins the Forget-Me-Not on the east.

Its area is 10 ac. The lease had been only lately applied for, and no work had been done in October last.

Coronet (M.C. 241).

Mgr., White.

Location, Etc.

The Coronet (or Cornet) lies, on a branch of Cone Creek, 2¾ miles north of the blast furnace on Mount Start, and only a few chains north of the Violet. The Gorge-Corella road passes across the northern part of the lease.

Its area is 20 ac. and, unlike most others, the lease is square. The ground was deserted during my stay in the locality last October, but is understood to be the property of the Willcocks Cloncurry Development Syndicate.

Development.

Two holes, 30 ft. apart, have been sunk here: a western, 6 ft. deep, and an eastern, 10 ft. deep and 20 ft. long. They are 4½ ch. south-west of the north-eastern corner.

Output.

1904 ... 22 tons were shipped by I. White (but the source is doubtful).

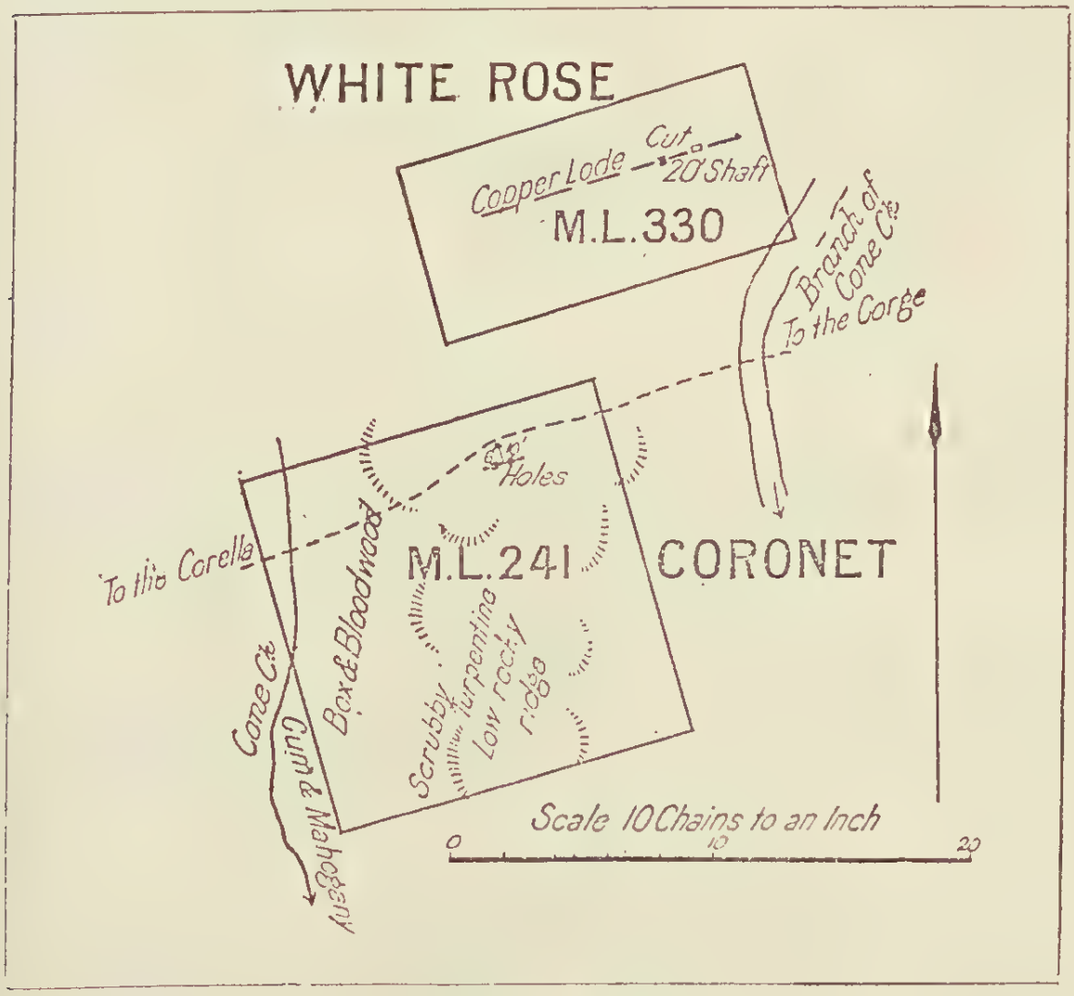
Ore-bodies.

The crop at the workings strikes east 12° north and dips 3 in 1 h. to the north-by-west, almost the sole case of a northerly dip noticed on Cone Creek. It is 2 ch. in length, and up to 10 ft. wide, and consists of quartz much stained by limonite.

The western hole exposes barren quartz, 20 in. wide, adjacent to the hanging-wall; then quartz, much of it crystallised and cemented by cupriferous limonite, 18 in. wide; formation, 9 in. wide; and quartz, 4 ft. wide, adjacent to the footwall. The country is chloritic schist. Some very fair bunches of malachite and tile-ore have been raised from this hole.

The eastern cut having caved in, little can be seen. The quartz from the cut is more cellular and iron-stained than any of the more

southerly crops, and some very cellular gossan has been found, giving encouragement for further sinking.



White Rose (M.L. 330).

Mgr., Allis.

Location, Etc.

The White Rose lies 3 ch. north of the Coronet.

Its area is 10 ac. It had apparently been long idle when visited in October last. The lease has now been taken over on option by the West Cloncurry Copper, Limited.

Development.

The workings consist of an opencut, 3 ch. from the eastern boundary; and of an inaccessible shaft, 20 ft. deep, 1½ ch. further west.

Output.

1906 ... 11 tons of ore shipped.

Ore-body.

The White Rose crop strikes east 15° north, and its dip is north-north-westwards.

The opencut exposes promising cupriferous formation, and the shaft has been sunk in ferruginous quartzite and schist, cemented, where jointed or crushed by malachite and limonite, the total width of the formation here being 5 ft. The seconds at grass amount to 6 tons and consist of quartz and schist cemented by malachite and limonite, with a little tile ore, the copper content approximating to 15%, and the silica content, at the same time, being very high.

Abandoned (M.L. ?).

Location, Etc.

This old holding lies ½ mile east of the White Rose, and a few chains north of the Gorge-Corella road.

Its area is not known, all attempts to find either the name or the number of the lease having failed. The ground was deserted during my stay in the locality, and had apparently been long idle.

Development.

The workings consist of an opencut, 40 ft. long and 4 ft. deep, in the central part of which is an underhand stope, 18 ft. long and 8 ft. deep. A shaft sunk from the bottom of the stope has now caved in.

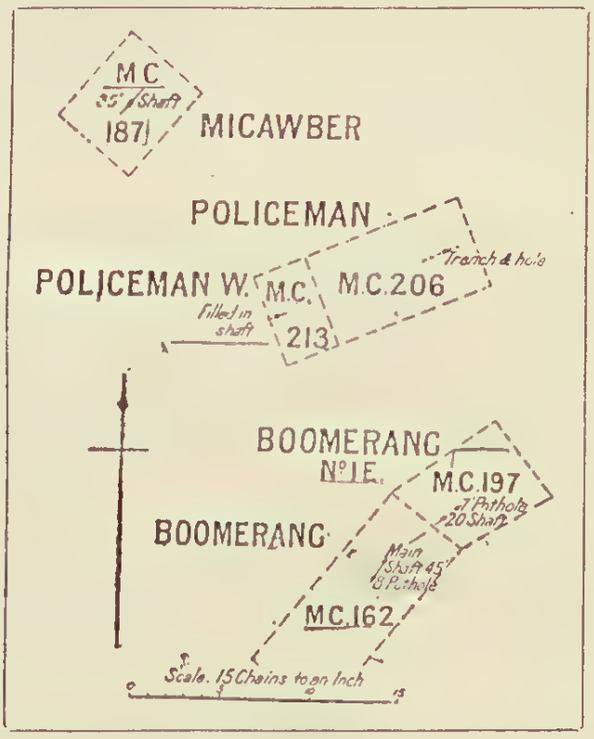
Ore-bodies.

The formation worked is believed to be on the line of the White Rose, here also dipping northwards. The country rock is a dense black slate, softened and bleached near the ore, where also slightly schistose, the walls of the ore-body being well defined but showing no sign of extensive movement. The faces of the workings exhibit a formation 9 in. to 12 in. wide and consisting of quartz, limonite, bornite and chalcopyrite, the first traces of the last being found within 6 ft. of the surface. The bornite, which has an iridescent purplish tint, is here massive, occurring as irregular bunches and veins both in granular quartz and crystalline calcite. The magnifying glass proves that it represents enriched chalcopyrite, though the inclusions of that mineral are seldom tesselated, and when they are the reticulating veinlets are always of limonite. In other ore-bodies on the Cloncurry fields, where chalcocite is the secondary mineral, the enclosed pyrite always exhibits a netting of the sulphide. Ore has been shipped from here, and 2 tons of very siliceous seconds remain at grass, the copper being present as bornite in limonite, with some stains of malachite. Ferruginous calcite is also present in some quantity in the heap of seconds.

In the present state of development it cannot be said that there is any ore in sight, but the faces warrant further opening up.

BOOMERANG GROUP.

The Boomerang Group includes four disconnected crops—the Boomerang, Policeman and Micawber, and Rainbow, not of any importance except in showing the frequency of crush-zone on Cone Creek.



Boomerang (M.C. 162).

Mgr., Holt.

Location, Etc.

The Boomerang is located on the western side of Cone Creek, $\frac{1}{2}$ mile north of the Daisy, and 2 miles north-north-west of the blast furnace on Mount Start.

Its area is 800 ft. x 350 ft. It was deserted when inspected, having been under exemption for a short time.

Development.

The main shaft, 45 ft. deep, is on the western side of the Cone Creek dray track; and from it a drive runs east for 10 ft. at 25 ft. below the surface. A second hole, 8 ft. deep, lies 1 ch. to the south-west-by-west.

Output.

		4 tons	shipped		
1906	...	2 ,,	,,	carrying 35 %	copper
		1 ton	at grass	,, 35 %	,,
		20 ,,	,,	,, 10 %	,,

Ore-bodies.

A crop of granular barren quartz and cupriferous schist, 5 ft. in width, runs south 35° west and east 38° north from the main shaft, in

which can be seen only lumps of quartz and copper-stained schist, though a 3 ft. bunch of 30 % ore was found at 13 ft. depth. About 2 tons of 35 % ore has been shipped from the main shaft, and 1 ton, estimated to carry between 30 % and 40 % copper, is now in the paddock. This ore consists of intimately associated chalcocite and limonite stained by malachite. The seconds, amounting to 20 tons and averaging 10 % copper comprise malachite, chalcocite, and a little azurite, chiefly in schist with not a large amount of quartz.

Boomerang 1 East (M.C. 197).

Mgr., Blosson.

Location, Etc.

This claim adjoins the Boomerang on the north-east.

Its area is 400 ft. x 350 ft. It was deserted when visited in October last.

Development.

Two shafts have been sunk: one, 20 ft. deep, lies 4 ch. north-east-by-east from the Boomerang main shaft; and the other, 7 ft. deep, about a chain beyond.

Ore-bodies.

The Boomerang formation strikes east 38° north in this claim. In the deeper shaft it consists of kaolinised schist quartz and gossan, with very little copper ore near the surface, though promising in appearance. The shallow shaft exposes schist with much quartz, and about 1 ton of 10 % ore (malachite-bearing schist) has been raised from it.

Policeman (M.C. 206).

Mgr., Moran.

Location, Etc.

The Policeman lies 10 ch. north of the Boomerang.

Its area is 600 ft. by 350 ft. No one was present on the ground when it was inspected in October last, though ore had lately been bagged. This ground has also been held under the title of the Shamrock.

A trench 20 ft. long and 5 ft. deep, with a hole 5 ft. deep in one end, has lately been opened, ¼ mile north-north-east of the Boomerang.

Ore-bodies.

The Policeman outcrop strikes east 28° north, and the greater part of it is, as usual, crushed schist with lenticular veins of quartz, the adjacent country being altered slate, only slightly schistose. The trench affords an exposure of a character different to all others seen on Cone Creek, except perhaps the Belfast, though possessing some similarity to those in the Slaty Creek catchment area to the north There

is here a vein 18 in. to 2 ft. 6 in. in width of jointed quartz and dark reddish ferro-calcite, with much fine grained, granular hæmatite and some chrysocolla. The richer ore consists of an intergrowth of chalcocite and tile ore, and of chalcocite and chalcopyrite, the last mineral being found more especially impregnating the cherty silicified ore, in which silica appears to have replaced limonite. About 4 tons of firsts running 20 % copper have been paddocked.

Policeman West (M.C. 213).

Mgr., Brady.

Location, Etc.

This adjoins the Policeman on the west, the workings on the two claims being 10 ch. apart.

Its area is 200 ft. x 350 ft. The ground appears to be abandoned.

A shaft has been sunk alongside the Cone Creek track, but has been filled in again to within 6 ft. of the surface.

Output.

1905 ... 9 tons shipped by Brady and Allis.

Ore-body.

The Policeman crop here strikes east 28° north. At the shaft there is a small lenticular body of quartz, and the chloritic schist adjacent to it is stained by malachite and iron oxides.

Micawber (M.C. 187).

Mgr., Osborne.

Location, Etc.

The Micawber lies 10 ch. north-west of the Policeman, and about 15 ch. south of the Ready Rhino.

Its area is 400 ft. x 350 ft. The claim was under exemption when visited because of the ore in sight being unpayable.

Development.

One shaft has been sunk between 35 and 40 ft., underlying steeply towards the south-east near the bottom.

Output.

1906	..	1 ton	shipped	carrying 24 %	copper
		20 ,,	at grass	,, 5 %	,,

Ore-bodies.

The Micawber crop strikes north 40° east, and underlies steeply to the south-east. It consists of granular quartz, much resembling quartzite, and to the south-west of the shaft it is 4 ft. wide. The greater part of the material raised is quartz, only 2 tons of export quality ore having been obtained. The seconds, amounting to 20 tons, are very siliceous, and carry not more than 5 % copper, as malachite, chiefly, though a little chrysocolla and chalcocite are present also.

Rainbow (M.L. 2454).

Location, Etc.

The Rainbow is situated just to the west of a short range, 2¼ miles north by east from the blast furnace on Mount Start and about a mile west of the Cloncurry-Duck Creek road.

Its area is 40 ac. It was deserted last year, but has lately passed into the hands of the Queensland Copper Freeholds, Ltd.

Literature.

For titles of reports, numbered as below, see Introduction.

(2.) Mr. Jack's report is:

The Rainbow Lode (marked "2454" on the map) lies about three and a-half miles to the south of Selection No. IX., on the fall of Cone Creek, a tributary of Duck Creek. It occurs in flat country, and shows a "blow" (striking WSW. and underlying to SSE.) of green carbonate of copper and gossan. A shaft has been sunk to the depth of 25 feet. The ore now lying at grass came from the bottom of the shaft, and is of very good quality—red oxide and green carbonate of copper (the latter enclosing quartz crystals), and silver-grey copper ore (sulphide of copper and antimony). The lode is traced for over 100 yards. At its west end it is crossed by a quartz reef running NW. and SE., and showing some red oxide of copper and some grey sulphide of copper and antimony. I consider the Rainbow quite a payable mine.

(7.) Mr. Rutherford says:

This consists of an irregular quartz outcrop in schist running east and west for a considerable distance. Associated with the quartz, especially at the eastern end, are green carbonate of copper and iron oxide. A shallow shaft shows that the quartz does not continue in depth. Some good ore is said to have been sent away from the surface diggings.

Development.

Only one shaft, 20 ft. deep, was seen here.

Ore-body.

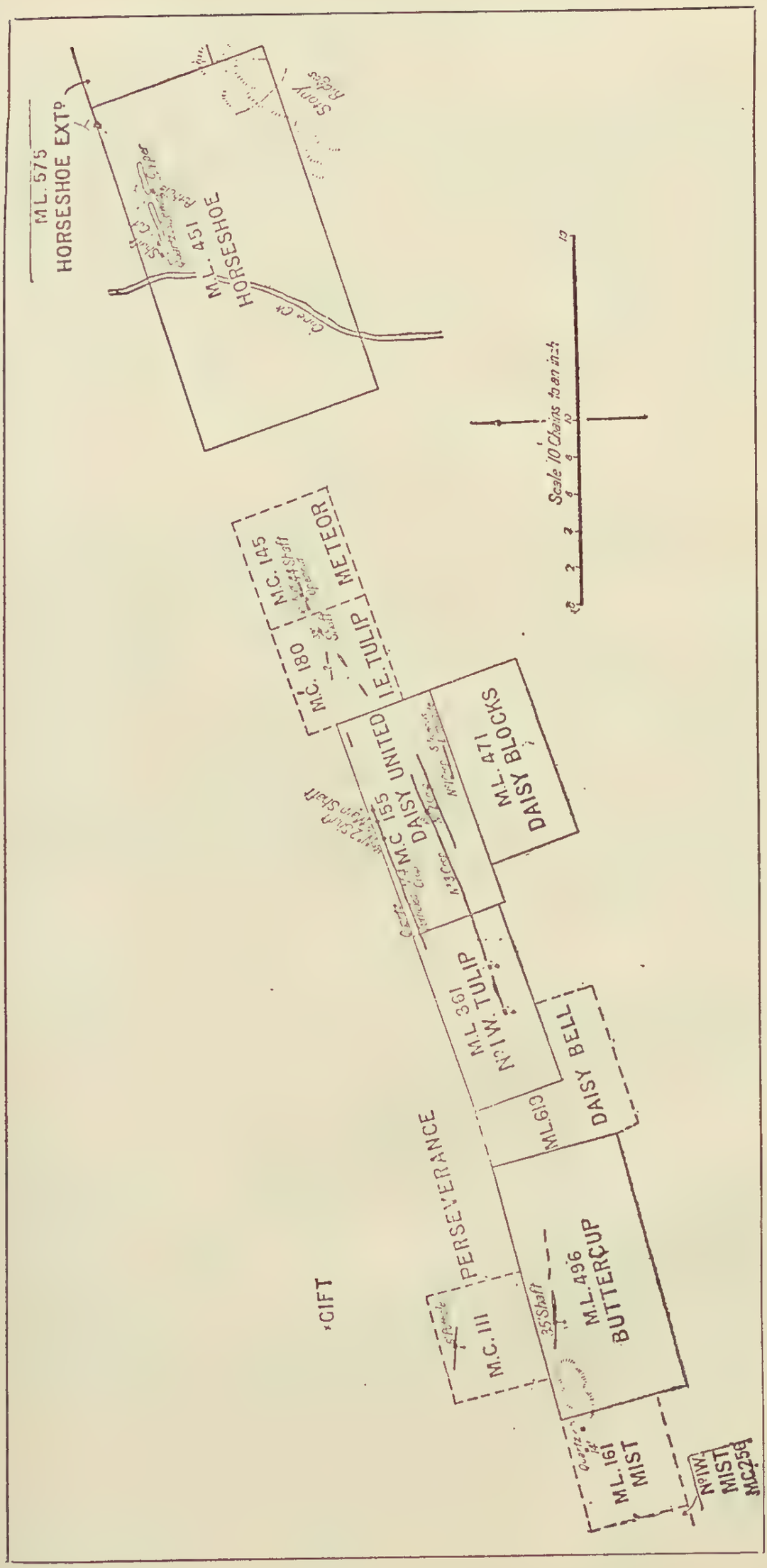
The Rainbow ore-body, which is in altered slate country, strikes east 20° south, and dips 70° to the south-south-west.

At the shaft it has a width of from 6 in. to 2 ft., and consists of strongly ironstained quartz, with cellular gossan and traces of malachite. Lumps of medium quality ore have been found on the surface for several chains to the east, and warrant further development.

A short distance to the north of the Rainbow an amygdaloidal rock similar to that found on the Daisy and Highland Mary was noted to occur in great quantity.

DAISY GROUP.

On the Daisy crush-zone there are only the Horseshoe, Meteor, Tulip East, Daisy United, Tulip West, Buttercup, Mist and Mist West; but the Woomera, Perseverance, Gift and Thistle are taken in the group because of their proximity to the main line.


M.L. 575
HORSESHOE EXTn
M.L. 451
HORSESHOE
Scale 10 Chains to an inch
M.C. 145
M.C. 180
METEOR
M.C. 155
DAISY UNITED
M.L. 361
N°1 W. TULIP
M.L. 471
DAISY BLOCKS
M.L. 610
DAISY BELL
PERSEVERANCE
M.C. 111
M.L. 496
BUTTERCUP
M.L. 161
MIST
MIST
MC.258
GIFT

Woomera (M.L. 302).

Mgr., Matheson.

Location, Etc.

The Woomera lies 1¼ mile north-by-east of the blast furnace on Mount Start, just to the east of the Cloncurry-Duck Creek road.

Its area is 10 ac. It is the property of the Willcocks Cloncurry Development Syndicate.

One shaft has been sunk in the north-eastern corner of the lease, but is now inaccessible.

Ore-body.

The ore-body is believed to strike east and west.

Horseshoe (M.L. 451).

Mgr., Corney.

Location, Etc.

The Horseshoe lies 1¼ miles north of the blast furnace on Mount Start. Cone Creek traverses it from north to south.

Its area is 20 ac. It was under exemption and deserted when visited in October last. The Celestial Copper and Option Company, Ltd., is understood to have since taken it over. The ground was formerly held as a claim and known as the Big Ben.

Development.

A shaft, now full of water, has been sunk 45 ft., at about 1 ch. east of the creek; 2½ ch. to the east-north-east is a small cut; and 1½ ch. to the east of the cut is a pothole, 5 ft. deep. There are also a few old trenches and potholes east again of this.

Output.

1905	...	5 tons	shipped	by Byrnes and Co.		
1906	...	14 „	„	„	„	
Total	...	19 „	„			

Ore-bodies.

The Horseshoe crop strikes east-north-east and has some resemblance to the Tharsis, than which, however, it is much poorer. On the west copper and ironstained schist, with numerous overlapping parallel lenticular quartz veins underlying southwards, crop within ½ ch. of the creek. The shaft was sunk in country on the northern side of this part of the crop, and disclosed very little ore. Some of that raised shows quartz fragments set in fine grained crystalline hæmatite, which is slightly impregnated by malachite and seamed by thin films of limonite. A crosscut should therefore be opened southwards from it.

The quartz-veined schist crop continued to the east-north-east for 7 ch., increasing from 20 ft. to 40 ft. in width. Within this area there are two specially prominent crops of quartz, one, 2½ ch. long and 10 ft. wide, beginning 1½ ch. east of Cone Creek, and the other, 2 ch. long and 6 to 8 ft. wide, lying ½ ch. to the east of the first. The former stands out 5 ft. above the schists, and the latter rises 10 ft. above the surrounding flats.

The quartz as usual is practically barren, but occasional bunches of poor ore are found in the adjacent and interlaminated schists, as at the central cut. The eastern pothole exposes only slightly copper-stained schist.

Meteor (M.C. 145).

Mgr., Absolon.

Location, Etc.

The Meteor adjoins the Horseshoe at the north-western corner, and lies ¼ mile north of the Cleopatra.

The area is 400 ft. x 350 ft. The claim was deserted when visited in October.

Development.

The main shaft, which is 44 ft. deep and underlies 4 in 1 h., is 2 ch. from the western boundary; at 20 ft., 40 ft. and 1½ ch. distance to the west there are potholes, each 10 ft. deep; and an opencut lies 30 ft. east of the last. Sinking in the main shaft is said to have ceased because of the water met with.

Output.

1904	...	8 tons	shipped	by Boyd
1905	...	15 ,,	,,	,, Hardess and Boyd.
Total	...	23* ,,	,,	
		5 ,,	at grass	seconds
		70 ,,	,,	carrying 10 % copper.

Ore-bodies.

The crop in this claim, part of the Horseshoe-Daisy-Buttercup line, strikes east 20° north underlying 4 in 1 h. to the south, and comprises 10 ft. width of quartz, with included copper-stained and ferruginous schist.

It is understood that copper ore was found in the shaft from the surface to the water-level, which is at the bottom. The ore last raised is quartz-bearing chloritic schist with veins and octahedral crystals† of

* Reported total 60 tons shipped, containing 25 to 30 % copper.

† Sometimes modified by the development of cube faces.

cupriferous pyrite; and of this there is about 5 tons at grass. The claim-holders are reported to have shipped 4 tons of 25 to 30 % ore (chalcocite and malachite) and tributers 1 ton more of similar quality.

The second pothole to the west is on a small pocket of ore.

The westernmost hole was opened on a body of secondary sulphides 18 in. wide, which apparently has not proved of any extent. There are 70 tons of seconds at grass, which should yield 10 % copper.

Tulip No. 1 East (M.C. 180).

Mgr., Leonard.

Location, Etc.

This adjoins the Daisy United on the east.

Its area is 400 ft. by 350 ft. Deserted.

Development.

One shaft has been sunk, a few chains west of the Meteor workings. It is 39 ft. deep, and has a 40-ft. crosscut north at the bottom, now inaccessible. It had lately been let on tribute.

Ore-bodies.

Three crops occur in this claim on a line running west 35° south, making an acute angle with the Daisy-Meteor line. The crops consist of quartz and chloritic schist, with abundant granules of limonite in the cupriferous parts, as well as a little actinolite.

A great quantity of quartz was met in sinking the shaft, and the copper content was not above 10 %; but in the crosscut there is reported to be 5 ft. 6 in. of granular quartz, replacing schist and impregnated with malachite, copper being present to the extent of 18 % —these figures presumably being maxima. The tributers failed to secure any shipping ore—20 % or over.

Daisy United (M.C. 155).

Mgr., Grey.

Location, Etc.

The Daisy United lies between the Tulip No. 1 East and the Tulip No. 1 West, 1½ miles north-north-west of the blast furnace on Mount Start.

Its area is 800 ft. by 350 ft., and it includes the two old claims known as the Daisy and Tulip.

Development.

One vertical shaft (*a*), 6 ft. x 5 ft. and 18 ft. deep, is located near the centre of the claim.

Three other shafts lie near the middle of the northern boundary, where work is now in progress. The main underlie shaft, 9 ft. x 6 ft., is 78 ft. deep, with stope extending back for 10 ft. from the shaft, between 30 ft. and 50 ft. from the surface; No. 2 underlie shaft, 35 ft. deep, is 1 ch. to the west-north-west and has drives 15 ft. east and west; and a pothole, 7 ft. deep, is 20 ft. to the east-north-east.

Output.

1905	...	4 tons	shipped	
1906	...	35 ,,	,,	*
		27 ,,	,,	by Grey and Long
Total	...	66 ,,	,,	†
		100 ,,	at grass,	seconds carrying 15 % copper.

Ore-bodies.

Four parallel outcrops, striking east 20° north, have been found on this claim. No. 1, near the southern boundary and 3 ch. from the south-eastern corner, consists of siliceous limonite, on which no work has yet been done.

No. 2 crop, which is visible for several chains, but is as yet untouched, lies 1½ ch. to the north, and comprises 2 ft. width of quartz and some copper ore.

No. 3 crop is 50 ft. to the north of No. 2, and can be traced through the greater part of the Daisy United into the Tulip West. At the shaft (*a*) is a vein of quartz 3 ft. wide, dipping 80° to the south-south-east in chloritic schist. The quartz has been found to carry a little gold. Bunches of rich but siliceous malachite and cuprite were found in sinking the shaft, but in all only 3 tons, carrying 33½% copper, have been shipped, and the 5% seconds at grass amount to but 1 cwt.

No. 4 crop dips 10 in 1 to the south-south-east. At the surface of the main shaft the formation is 4 ft. wide; at 40 ft. below, it pinches to 3 ft. width; but at 70 ft. below, the lowest accessible, it is 9 ft.; and, in the bottom, is stated to be 12 ft. The walls are well marked and the hanging-wall exhibits occasional horizontal slickensides. Malachite and tile-ore showed at the surface, but below in the shaft much chalcopyrite, intricately veined by chalcocite and assaying up to 45% copper, has been found. Near the bottom, which is believed to be

* One parcel of 20 tons ran 33 %, and yielded a profit of £11 clear of expenses.

† Mr. Gray informed me that a total of 84 tons had been shipped, carrying 27 to 35½ % copper.

just above the water-level, bunches of powdery secondary sulphides occur in the schists, together with elongated octahedral crystals of pyrite, on each side of a horse of quartz, which came in at 45 ft. below the surface. Of the total width at 70 ft depth 7 ft. consists of quartz, all of which has to be raised. The section exposed in the ends of the shaft is as follows: Adjacent to the footwall 12 in. chalcopyrite and chalcocite bearing formation; 5 ft. quartz with bunches of chalcocite and also of chlorite; 2 ft. quartz with a larger proportion of chalcocite; and 12 in. quartzose formation carrying chalcocite, adjacent to the hanging-wall. In all 80 tons of firsts, assaying from 27 to 35½% copper, have been separated, and 100 tons of seconds, averaging 15% copper, are paddocked at the shaft. The clear profit to the claim-holders over all expenses, except mining, has, with copper at £80 per ton, amounted to £16 per ton of ore shipped.

The exposures in No. 2 shaft much resemble the above, there being a central body of poor quartz, 3 ft. thick and dipping 5 in 1 h. to the south-south-east, with 3 ft. width of cupriferous formation on the south, and 18 in. width on the north, but much earthy calcareous sinter (locally known as kaline) has been deposited here in the ore-body as well as in the hanging-wall country.

Malachite and tile-ore were got in the upper part of the shaft, but metallic chalcocite (glance) and chalcopyrite are coming in towards the bottom. The western drive is in the hanging-wall formation, which here consists of chloritic schist, strongly impregnated over the whole width of the drive with malachite and glance. The eastern drive is in much more siliceous ore, though just above it in the shaft there is 2 ft. 6 in. width of bagging ore.

The country rock exposed in the workings is schist, but there are several outcrops in the southern part of the claim of a highly metamorphosed slaty rock. This has a fine-grained siliceous base of neutral tint, and scattered through it are spheres ⅛-in. in diameter, of radiating, greenish actinolite, irregularly shaped grains, up to ¼-in. in diameter, of calcite, and small bundles of yellow epidote needles, more especially in or near the calcite.

Daisy Block South (M.L. 471).

Location, Etc.

This adjoins the Daisy United on the south.

Its area is 5 ac. Work has not yet begun here.

Tulip No. 1 West (M.L. 361).

Mgr., Leonard.

Location, Etc.

This adjoins the Daisy United on the west.

Its area is 5 ac. It was exempt and deserted when visited, and the lease has been held for 2 yrs.

Development.

The workings comprised two shafts, each 6 ft. deep, at 3 and 5½ ch. respectively from the eastern boundary.

Output.

$\frac{15}{20}$ tons shipped, containing 40 % copper.

Ore-bodies.

The No. 3 line of the Daisy United makes several small crops in this lease, and between these the potholes have been opened. The ore now visible is rubbly, and very low in grade.

Daisy Bell (M.L. 619).

Mgr., Connell.

Location, Etc.

The Daisy Bell includes ground left between the Tulip No. 1 West and the Buttercup.

Its area is 4 ac.

One hole has been sunk 6 ft. in rubble.

Buttercup (M.L. 496).

Mgr., Jones.

Location, Etc.

The Buttercup lies 15 ch. west-south-west of the Daisy.

Its area is $9\frac{8}{10}$ ac. It was let under tribute at the time of my visit.

Development.

The shaft is 5 ch. east of the north-western corner peg. It is 35 ft. deep, and has drives 20 ft. and 15 ft. to the east and west respectively, at the 30 ft. level, a stope above the latter extending to the surface. Work is now in progress here.

Output.

1906 ...	4 tons	shipped	from Buttercup
Total ...	4 ,,	,,	*
	30 ,,	at grass,	carrying 12 % copper.

Ore-bodies.

A formation, presumably one of the southern Daisy lines, here striking east and west, is being tested on this lease. The shaft lies on

* It is reported that 20 tons of 25 % ore have been shipped, one parcel of 3 tons of 23⅓ % ores despatched to South Australia in May, 1906, yielding a profit of £7 per ton, clear of all expense, except mining.

the line of strike of the Daisy main northern zone, which, however, is believed to have bent round and to run 5 ch. to the north of the Buttercup. The formation is schist and quartz, containing bunches and stains of tile-ore, cuprite, and malachite, veined in the lower part of the shaft with glance. In the western drive the rich ore has gradually decreased in quantity, that over 3 ft. width in the face being worth not more than 10% copper, but at the same time being comparatively low in silica. In the face of the eastern drive is exposed: 6 in. copper-stained quartz on the footwall; then, 12 in. schist rich in malachite, cuprite and glance; and then 3 ft. of copper-stained quartz. Some small octahedral crystals of limonite (pseudo-morphous after pyrite ?) were noticed in the richer ore.

The seconds at grass amount to 30 tons and are expected to run from 12 to 15% copper.

The country rock is schist, the footwall in places being slickensided, unlike the hanging-wall, which, however, is well defined. The dip, as all along the line, is to the south.

Mist (M.C. 161).

Mgr., Brady.

Location, Etc.

The Mist adjoins the Buttercup on the west.

Its area is 200 ft. x 350 ft. The ground was unmanned when inspected.

Development.

The workings comprise a pothole and a 14 ft. shaft, ½ ch. and 1½ ch. respectively west of the Buttercup boundary.

Ore-bodies.

There is here a crop 6 ft. wide of quartz, seamed with gossan, and in the shaft both tile-ore and malachite have been found.

Mist No. 1 West (M.C. 256).

Mgr., Brady.

Location, Etc.

This adjoins the Mist on the west.

Its area is 200 ft. x 350 ft.

Perseverance (M.C. 111).

Mgr., Church.

Location, Etc.

The Perseverance adjoins the Buttercup on the north.

Its area is 400 ft. x 350 ft. It was deserted in October, and apparently abandoned.

Only one pothole, 6 ft. deep, has been opened—between 5 and 6 ch. north of the Buttercup shaft.

Ore-body.

A siliceous crop, 5 ft. thick and 3 ch. long here strikes east and west and is believed to be on the northern crush-zone of the Daisy. The patch of gossan opened is poor in copper, but its apearance warrants some further work here.

Literature.

For title of report, numbered as below, see Introduction.

(8) Mr. Gibb gives the following analysis of ore from the Perseverance (Iron Cross Course), Duck Creek (Government Analyst):—

Copper	=	6·7 %
Silica	=	17·0 %
Iron protoxide	=	61·7 %
Alumina	=	2·6 %
Lime	=	trace
		88·0 %

Gift (M.C. 194).

Mgr., Brady.

Location, Etc.

The Gift lies about 12 ch. north of the Buttercup.

Its area is 200 ft. by 350 ft. It was deserted when inspected.

Development.

One shaft has been sunk 30 ft.

Output.

30 tons shipped, carrying 40 % copper.

Unknown (M.C. ?).

Mgr., Dally.

Location, Etc.

This lies about 7 ch. west of the Gift, and 12 ch. north of the Mist.

The claim being deserted, its area could not be ascertained.

A hole has been sunk 7 ft.

Output.

$\frac{10}{20}$ ton shipped carrying 30 % copper (reported).

Ore-body.

The outcrop consists of 3 ft. width of gossany quartz and schist, striking east-north-east.

Thistle (M.C. ?).

Location, Etc.

This lies $\frac{1}{2}$ mile north-west of the Buttercup.

Its area is not known, the ground being deserted and presumably abandoned, as not on the list of living claims and leases.

Development.

One shaft has been sunk to a depth of 24 ft., and a drive has been opened 4 ft. to the west at the bottom.

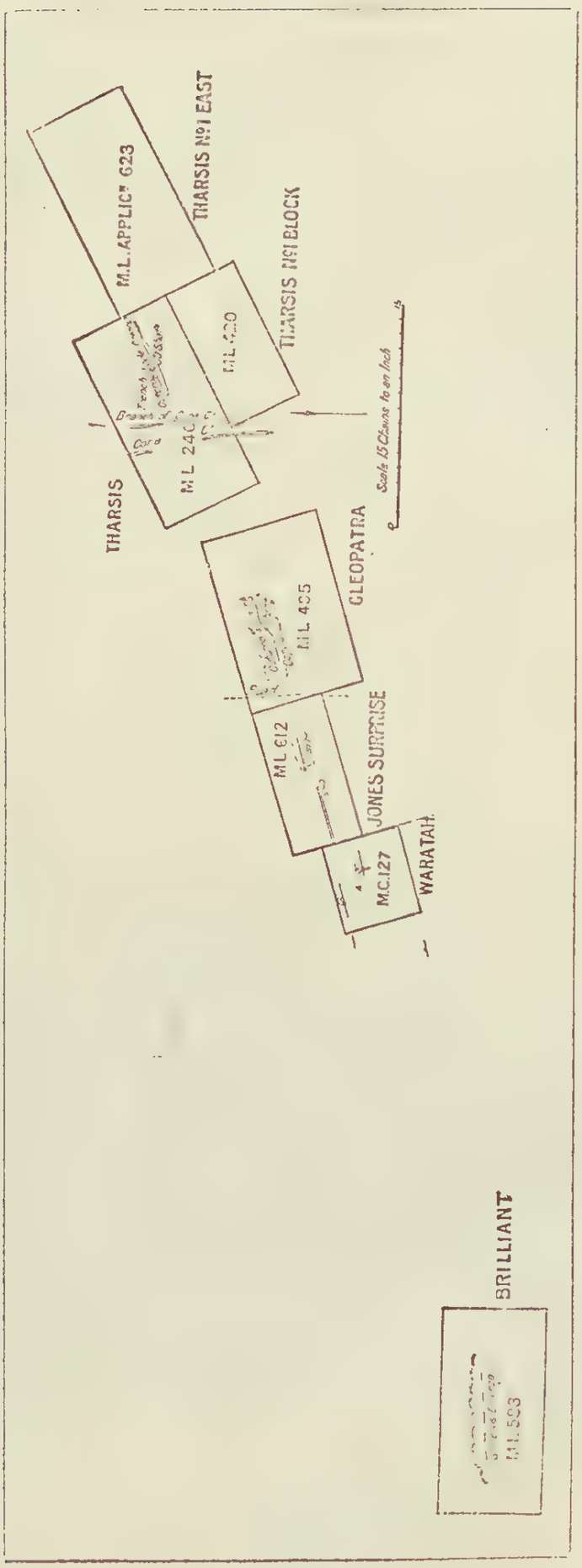
Ore-bodies.

An outcrop of granular quartzite, in chloritic schist, here strikes east 30° north, but, just to the west-south-west of the shaft, makes a bend and runs almost due west. Very little ore is visible in the crop but a little silicified limonite and chrysocolla was found near the shaft bottom, and in addition to a little malachite-stained gossan in the drive. The probability is, therefore, that very low-grade pyritic ore would be found on sinking.

About 20 ch. west of the shaft a patch of fine-grained cellular hæmatite has been located in the quartzite crop, the country here being slate.

THARSIS GROUP.

The Tharsis Group comprises the Brilliant, Waratah, Jones' Surprise, Tharsis, Tharsis East and Tharsis Block, all on the one crush-zone, which is marked by occasional siliceous outcrops of great size.


THARSIS
M.L. APPLIC.N 623
THARSIS No.1 EAST
M.L 240
M.L 620
THARSIS No.1 BLOCK
Scale 15 Chains to an Inch
CLEOPATRA
M.L 435
ML 612
JONES SURPRISE
M.C.127
WARATAH
BRILLIANT
M.L.503

Brilliant (M.L. 588).

Mgr., Staubwasser.

Location, Etc.

The Brilliant lies ½ mile west-south-west of the Waratah, and 1½ mile north-west of the blast furnace on Mount Start.

Its area is 10 ac. The ground was previously held as a claim, under the name of the Jumbo.

Development.

The workings consist of one inaccessible shaft, 40 ft. deep, and one or two shallow holes 3 ch. from the eastern boundary and 1 ch. from the northern.

Output.

	2½ tons	shipped	by original prospectors (reported.)
1906 ...	5 ,,	,,	,, Hughes
Total ...	7½ ,,		
	5 ,,	at grass	carrying 10 % copper.

Ore-body.

The workings are situated in speckled siliceous schist, 3 ch. east of

Fig. 12 (natural size).—Rich oxidised ore, Brilliant.

1. Crypto crystalline malachite and chalcocite.
2. Earthy turgite.
3. Chrysocolla.

a great blow of quartz and quartzite, extending westwards for several chains and having some resemblance to a kneeling elephant. Only 2½ tons of ore have been shipped and 5 tons of seconds now lie at grass. The seconds, of which the copper content is not above 10 %, consist in great part of granular quartz, evidently replacing schist, and cemented by malachite and chrysocolla, with a little limonite, chalcocite and chalcopyrite.

The richest ore is a peculiar intergrowth of chrysocolla and malachite with earthy turgite, the last being in minute irregularly shaped particles, roughly aligned, in a base of the first and second. (Fig. 12). The copper minerals are seen to be in process of replacing chloritic schist, originally separating grains, lumps, and lenses of quartz. Some parts of the ore have suffered extensive silicification subsequently to partial oxidation of the chalcopyrite, that mineral now being often set in a dark siliceous matrix, also cementing white lumps and colourless crystals of quartz.

Waratah (M.L. 127).

Mgr., Wallace.

Location, Etc.

The Waratah lies ½ mile north of the Blue Bell, and a little over 1 mile north-west of the blast furnace on Mount Start.

Its area is 400 ft. x 350 ft. Idle when inspected, most of the work having been done during 1905.

Development.

Two shafts have been sunk, one near the centre of the claim to a depth of 30 ft. (inaccessible) and one 2½ ch. to the north-west, to a depth of 12 ft. Trenches have also been opened for 30 ft. east and west of the first shaft.

Output.

	15	tons	shipped	containing	30 %	copper	(reported)
	5	,,	,,	,,	40 %	,,	,,
Total ...	20	,,	,,				
	5	,,	at grass	seconds.			

Ore-bodies.

There are two well-defined parallel lines of outcrop on this lease, striking east-north-east and underlying 5 in 1 h. to the south-south-east. The eastern trench on the southern and larger crop exposes up

to 5 ft. width of schist and quartz formation, underlying steeply southwards. It is reported that 15 tons of 30 % ore have been sent away, but the last 5 tons shipped yielded only 25 % copper. The seconds at grass amount to 10 tons, and consist of siliceous malachite, with perhaps 12 % copper.

The northern formation of quartz and crushed schist is 2 ft. 6 in wide and is on the line of strike of that worked in the Jones' Surprise. There was only a small seam of rich ore, but 5 tons of 40 % ore have been shipped from here; and 5 tons of seconds—siliceous tile-ore and malachite—are at grass.

A third line of formation, which should pass near the southern boundary of the claim, has been tried in a pothole 7 ch. west-south-west of the 30 ft. shaft.

Jones' Surprise (M.L. 612).

Mgr., Jones.

Location, Etc.

The Jones' Surprise is east-north-east of the Waratah, and west of the Cleopatra.

Its area is 5 ac. The lease had only just been taken up, in October last, having been formerly held as a claim by Hardist and Price.

Development.

The workings comprise: a shaft near the centre of the lease, originally 40 ft. deep but now caved in below 15 ft. from the surface; and a pothole 5 ft. deep, ½ ch. to the west-south-west.

Output.

Total ...	4 tons	shipped (reported)

Ore-bodies.

This lease takes in a prominent outcrop, 3½ ch. in length and 15 ft. in greatest width, similar in character to, though smaller and richer than, that on the Tharsis, on the line of strike of which it occurs. The country rock is schist and the outcropping formation, which dips steeply to the south, consists chiefly of dense quartz, with patches of chlorite and bands of schist impregnated with copper ores, chiefly along the centre of the crop where crushed. The rich ore, of which only 4 tons have been shipped from the shaft, occurs in bunches, the average tenor being low.

Cleopatra (M.L. 495).

Mgr., Johnson.

Location, Etc.

The Cleopatra adjoins the Jones' Surprise on the east-north-east and is separated on the north-east by only 2 ch. from the Tharsis.

The country hereabouts is all flat, worn down.

Its area is 10 ac. The lease was under exemption, and deserted in October last.

Development.

One shaft, 7 ft. x 4 ft., has been sunk vertically, near the centre of the lease, to a depth of 40 ft.

Output.

1906	...	$2\frac{4}{20}$ tons	shipped	by H. Johnson
		5 ,,	at grass,	carrying 20%

Ore-bodies.

A part of the Tharsis-Waratah crush-zone makes a large crop on this lease, $4\frac{1}{2}$ ch. in length. Just at the shaft it strikes north-east, dipping very steeply to the south-east, but on the east it bends round and runs for $1\frac{1}{2}$ ch. east-north-east towards the Tharsis and on the west runs for 3 ch. west-south-west towards the Jones' Surprise crop. The whole of the sinking was in a formation of jointed quartz lenses separated by crushed country. The quartz contains no copper ore, but flakes of chlorite are plentifully disseminated in parts of it. The interstitial schist is impregnated with limonite, malachite, tile-ore azurite, chrysocolla and very faint splashes of glance. About 5 tons of ore that should carry 20% copper have been picked out and paddocked.

Tharsis (M.L. 240).

Mgr., Matheson.

Location, Etc.

The Tharsis lies $1\frac{1}{4}$ mile north of the blast furnace on Mount Start, and Cone Creek runs across it from north to south.

Its area is 10 ac. It is the property of the Willcocks Cloncurry Development Syndicate.

Development.

The workings consist of an almost vertical shaft, 6 ft. x 3 ft., and 50 ft. deep, about 6 ch. south-south-west of the north-eastern corner; deep trench running 20 ft. north of the shaft; and an opencut, 120 ft.

long, 6 to 8 ft. wide and 7 ft. deep at the western end, 2 ch. east-north-east of the shaft. The opencut is being carried westwards from the eastern end of the crop.

Output.

1906	...	90 tons	at grass	carrying 12 %
		100 ,,	,,	,, 3 %

Ore-bodies.

The Tharsis outcrop, which lies 2 ch. east of Cone Creek, is 6 ch. long and 42 ft. in greatest width, in the western part near the shaft, whence it tapers gradually towards the east. The crop rises, as a rounded ridge, 10 ft. above the surrounding flats. Its strike is east-north-east, and its dip is 6 to 7 in 1 h. to the south.

The crop consists of crushed schist, with crowded lenticular veins of quartz, the visible silica amounting to at least 50 % of the whole formation. The quartz has presumably segregated during the production of schistosity in the country rock, and that some of it has replaced country rock is indicated by the smooth partings noticeable throughout the formation, even where wholly of quartz. Some of the quartz is in the form of interlocking crystals and the interspaces are often occupied by a green chloritic mineral, the unreplaced residium of the original country rock. A few of the joints in the outcrop quartz are coated with malachite, but almost the whole of the copper-ore occurs as stains on the laminæ of the schist and as bunches in the same. Some of the bunches visible in the crop northeast of the shaft are 4 ft. in length and 2 ft. across and carry 10 % to 30 % copper, as malachite and tile-ore, but they are often separated by 5 ft. of very low-grade material.

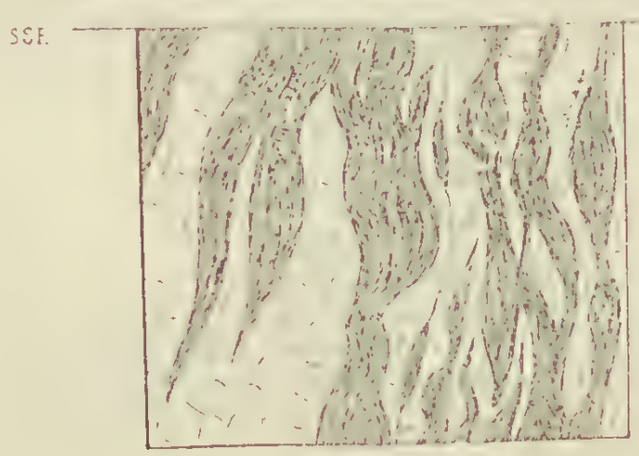


Fig. 13.—Western end of opencut, Tharsis.

Scale : 4 ft. to an inch.

1. Quartz (cupriferous part dotted).
2. Schist (,, ,, ,,).

The face of the opencut exposes lenticular masses of quartz and schist dipping 7 in 1 h. to the south. (Fig. 13.) The quartz, which amounts to two-thirds of the whole, carries very little copper, but the interlaminated schists should average 5% copper as malachite. About 90 tons of ore, estimated to carry 12 % copper, have been stacked alongside the cut, the copper occurring chiefly as malachite staining the schist, but also to a small extent as tile-ore. The silica content is over 50 %, but iron should reach 10 %. The rejected material from the cut should carry 2 % copper.

The trench running north from the shaft exposes similar formation, dipping southwards 6 in 1 h. and averaging 7 % copper by the manager's assays.

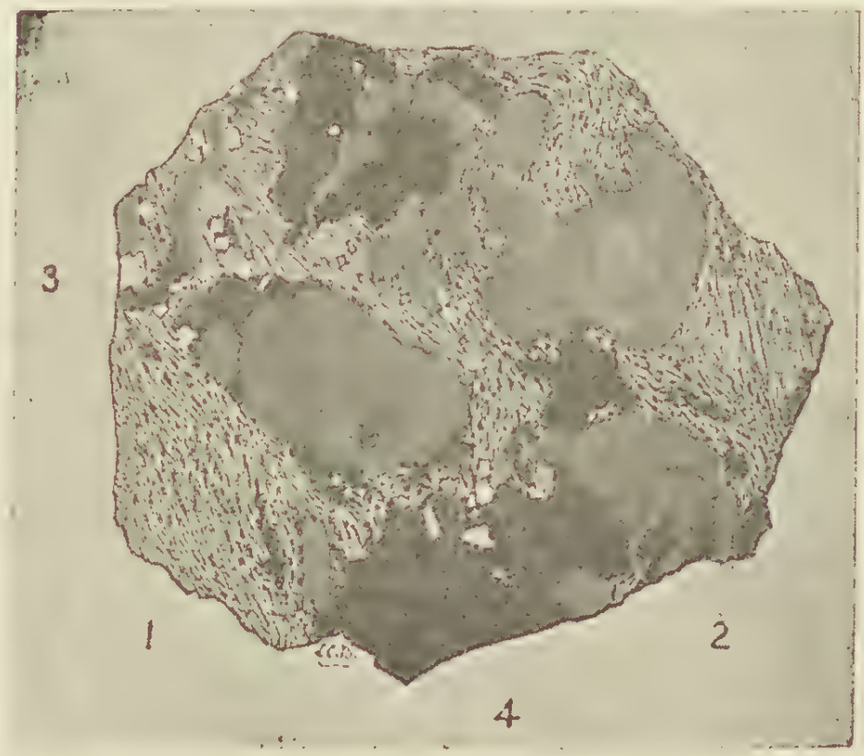


FIG. 14 (NATURAL SIZE).—TYPICAL ORE, 50 FT. LEVEL, THARSIS.

1. Schist *3. Pyrite*
2. Quartz *4. Chalcocite.*

The whole of the shaft is in schist-quartz formation with carbonates in the upper part but with bunches of chalcocite as well towards the bottom, where there is one 18 in. in diameter and carrying at least 30 % copper. There is also at the bottom a 9 in. band of red gossan, with a sprinkling of malachite, making its copper content 2 %, even if tile-ore is absent. Mr. Matheson has estimated from his assays that the whole of the material raised from the shaft should average

8 % copper. My surface sample from the whole of the dump consists of equal parts of quartz and schist. The quartz is crystalline and barren except for external films of malachite. The schist is chloritic, is stained throughout by malachite and in places by gossan, and contains a little chalcocite (glance) adjacent to quartz. (Fig. 14.) The following is the result of assay (Government Analyst):—

Copper	=	3·3 %
Gold	=	20 gr. per ton
Silver	=	2 dwt. ,,

The shaft has thus proved that, in one part at least, the formation is no less cupriferous at 50 ft. below than at the surface, and it does not appear to have been sunk in a specially favourable locality. Consequently a large supply of low-grade siliceous ore is to be relied on from this lease.

Tharsis No. 1 East (M.L. 623).

Location, Etc.

This lease adjoins the Tharsis on the east.

Its area is 10 ac. It was deserted in October last, work having not yet commenced.

Ore-bodies.

There are no crops on this ground.

Tharsis No. 1 Block.

Mgr., Corney.

Location, Etc.

This adjoins the Tharsis on the south.

Its area is 5 ac. It was not manned in October last, and work had not then commenced on it.

Ore-bodies.

No crop is visible on this lease, which has been taken up with the intention of sinking for the Tharsis ore-body if circumstances warrant it.

BELFAST GROUP.

The Belfast group includes only the one lease, which is to some extent isolated from others on Cone Creek. The ore-body is due to regional metamorphism, but it has not been proved to lie on a crush-zone.

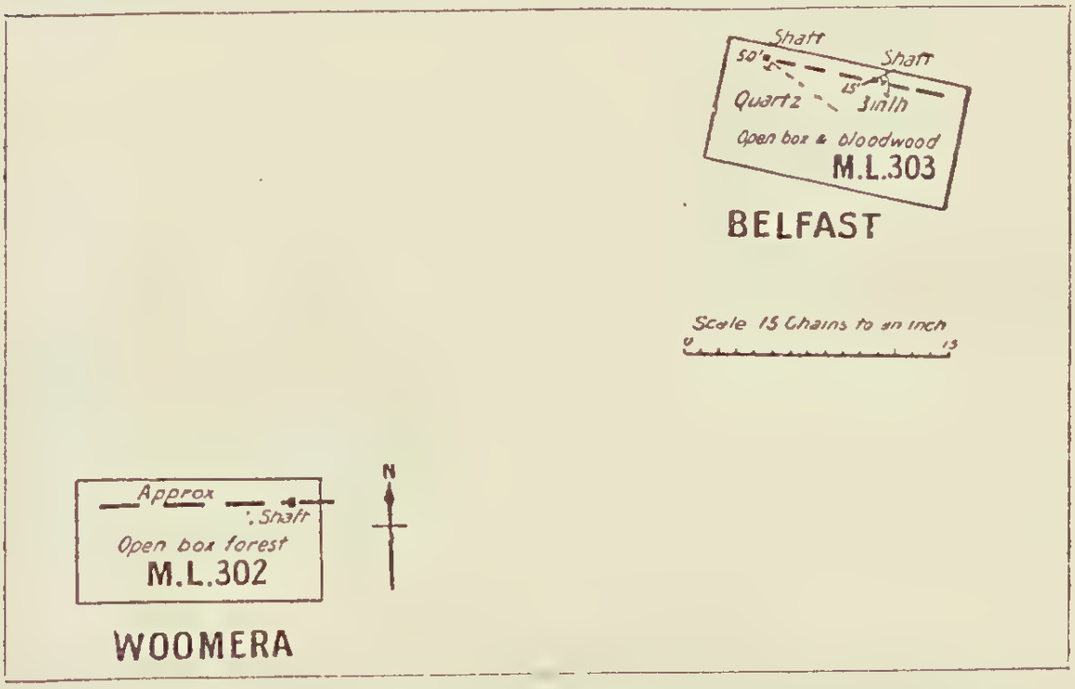
Belfast (M.L. 303).

Mgr., Matheson.

Location, Etc.

The Belfast lies in flat country 2 miles north-north-east of the blast furnace on Mount Start, and 10 ch. south-east of the Cloncurry

road. The mine is located in a flat-bottomed valley between a north and south row of worn-down hills, the backbone of a former range,



about a mile to the east and the still less significant Rainbow ridge to the north-west.

Its area is 10 ac. It is the property of the Willcocks Cloncurry Development Syndicate, which was opening it up at the time of my visit. Some confusion has arisen concerning the name of this lease, the manager referring to it in his reports as the Alabama.

Development.

The main shaft is located 2½ ch. south-east of the north-western corner. It is accessible to a depth of 40 ft., where there is a staging and a drive 12 ft. to the north-west, but it is understood to have a total depth of 50 ft.* Another shaft, 15 ft. deep, lies 6 ch. to the east-by-south.

Output.

1906 ... 50 tons at grass carrying 15 % copper.

Ore-bodies.

A few boulders of ironstained quartz and calcite constitute the crop at the main shaft. The strike appears to be east 38° south, towards a quartz crop near the centre of the lease, the dip being 2 in 1 h. to the south-west. The exposure in the main shaft is of a rather different character to most others on Duck Creek waters, consisting as it does of a cavernous formation made up of quartz, calcite and earthy gossan, in which chiefly the copper ores occur. The formation in the south-eastern end of the shaft is 3 ft. wide, but is not being

* Subsequently to my inspection some stoping was done above the 40-ft. level.

broken down. In the drive on the opposite side of the shaft a total width of 8 ft. to 10 ft. of formation is being stoped out. Over one-half of it is quartz, and one-quarter cavernous calcite, the remainder being earthy-brown cupriferous limonite, which, besides being found between masses of quartz and limonite, forms a 12 in. band on the hanging-wall and a 6 in. to 18 in. body adjacent to the footwall quartz, the two bands being separated by 5 ft. of irregularly interpenetrating quartz and calcite. Chrysocolla occurs in the limonite, more especially in the calcareous nodules and some irregular bunches of chalcocite have been struck as well as tile-ore, but most of the copper is present as malachite. Most of the quartz contains cupriferous pyrite (perhaps leached chalcopyrite), generally surrounded by limonite. Secondary silica is very plentiful, both crystallised in cavities in the limonite and in amorphous form throughout the oxidised ore, cracks in which are filled with chrysocolla. Micaceous hæmatite is to be seen in bunches in the calcite, and also in thin sheets along the cleavage planes of the same mineral.

Some ore has been shipped, but the 50 tons paddocked at the shaft are not expected to run above 15%. My surface sample from this paddock contains: one quarter limonite and turgite with crystals of the original chalcopyrite (in process of alteration into limonite and glance), a little crystalline cuprite, fibrous malachite and coatings of earthy malachite on cracks, besides a little chrysocolla in the less siliceous turgite; one quarter very cellular but rather siliceous gossan, containing a little acicular malachite; one quarter ferruginous granular quartz, with bunches of siliceous gossan and coatings and fillings of chalcocite; fairly pure chalcocite (glance) veined by silica and coated with malachite; slightly ferruginous calcite with some chalcocite bearing limonite; a little dark schist stained by malachite; and occasional plates of hæmatite in the kaolin. Such ore, even though low in copper, would be valuable to the smelter for its iron and lime contents. The following is the result of assay (Government Analyst):—

Copper	=	14·8 %
Gold	=	1 dwt. per ton
Silver	=	1 ,, ,,

The eastern shaft is in a granular siliceous slate, on a separate body striking east 25° north, and dipping 3 in 1 h. to the south-south-east; and about 3 ch. from the quartz crop at the calculated intersection of the two lines. The ore-body in the shaft averages 12 in. in width, and consists of coarsely foliated specular iron (often beautifully rosetted and evidently replacing schist), gossan, limonite, calcite, malachite (some of it between the foliæ of the hæmatite), tile-ore, and dioptase (?). There are 5 tons of ore at grass, the copper in which does not exceed 5%. The ore may, nevertheless, be of value to the smelter, and the occurrence is of importance as indicating that the ore-bodies are due to regional metamorphism.

PIONEER CHIEF GROUP.

The Pioneer Chief Group is a scattered one, and includes four (possibly five) separate lines, on which are: the Blue Bell, Pioneer Chief and Marabah; the Noontide and Try Again; the Alabama; and the Easter Gift. None of these crops is of any extent.

Pioneer Chief (M.L. 231).

Mgr., Walsh.

Location, Etc.

The Pioneer Chief is situated on the eastern bank of Cone Creek, ½ mile north of the blast furnace on Mount Start. The Cloncurry-Duck Creek road passes close to the workings.

The area is 20 ac. The lease is the property of the firm of Graham and Matheson, who purchased it from Price and Wallis, the prospectors, in May, 1906.

Literature.

For title of report, numbered as below, see Introduction.

(8) Mr. Gibb tabulates the following analyses (Government Analyst):—

(s) Selected for shipment—

Copper	=	28·0
Silica	=	12·2
Iron protoxide ...	=	21·0
Alumina	=	1·6
Lime	=	7·5
Sulphur	=	5·7
		76·0

Gold = 7 dwt. 19 gr. per ton.
Silver = 1 ,, 5 ,, ,,

(r) Rejected from ore raised—

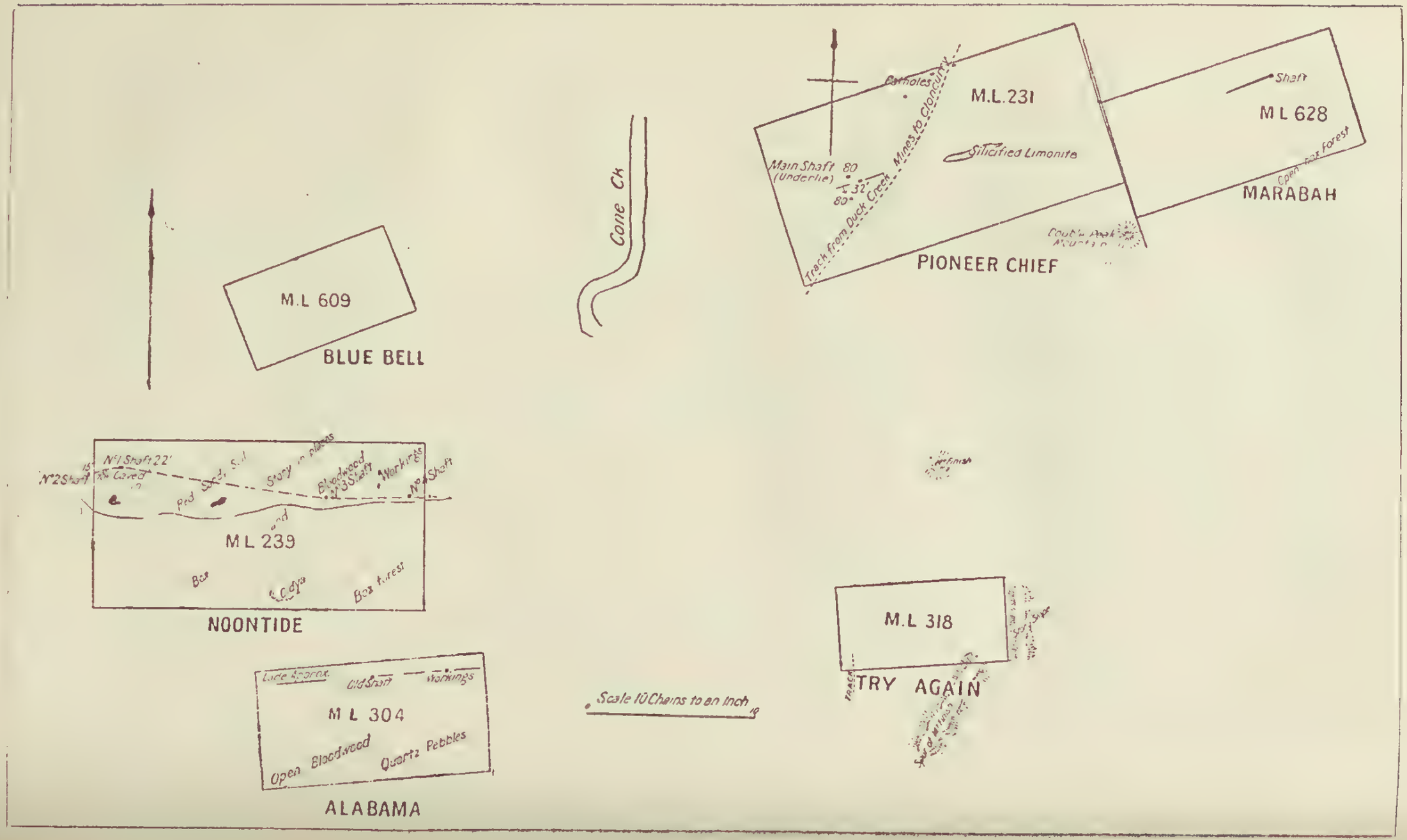
Copper	=	11·8
Silica	=	21·0
Iron protoxide ...	=	24·4
Alumina	=	4·0
Lime	=	9·3
Sulphur	=	0·4
		70·9

Development.

The main shaft, vertical to 30 ft. and then underlying 80° for 55 ft., is about 4 ch. south-east from the north-western corner peg. The intention was to sink to 100 ft. and then to block out the ore, there being already a drive 25 ft. to the west at the 50 ft. level.* The water met in sinking has caused much inconvenience, necessitating the installation of a steam pump—10,000 gall. a day being rather too heavy to cope with by baling.

Another shaft, 32 ft. deep, lies ½ ch. east-south-east from the main one; and a pothole is 5 ch. to the north-north-east of the same.

* The warden reported, in Jan., 1907, that the shaft was 115 ft. deep and that at the 104-ft. level drives were carried 20 ft. east and 23 ft. west.


M.L 609
BLUE BELL
Conie Ck
Cutholes
M.L.231
Mines to Cloncurry
Main Shaft 80
(Underlie)
I 32°
80°
Track from Duck Creek
Silicified Limonite
PIONEER CHIEF
Shaft
M L 628
Open box forest
MARABAH
N°1 Shaft 22'
N°2 Shaft
N°3 Shaft
N°4 Shaft
Workings
Bloodwood
Stony in places
Sand, Soil
Pond
M L 239
Box
Gidya
Box forest
NOONTIDE
Old Shaft
Workings
M L 304
Open Bloodwood
Quartz Pebbles
ALABAMA
Scale 10 Chains to an Inch
M.L 318
TRY AGAIN

Output.

1904	...	$106\frac{10}{20}$ tons	shipped by Price and Wallis
1905	...	5 ,,	,,
1906	...	29 ,,	,,
		$140\frac{10}{20}$	
		? ,,	at grass (material not sorted).

Ore-bodies.

The Pioneer Chief ore-bearing zone made little or no show near the main shaft, but 3 ch. to the east there is a barren crop 2 ch. long and up to 10 ft. wide—a crystallised quartz-bearing gossan indurated by a deposition of secondary chalcedonic silica, the quartz crystals now being set in a paste of silicified limonite. This should be tested by driving from the main shaft.

In the main shaft no defined ore-body was met within 20 ft. of the surface, that below dipping 80° to the south. Above the water-level, which is at 50 ft. beneath the surface, the ore was chiefly red clayey gossan and tile-ore, with bunches of chalcopyrite, enriched by chalcocite, but much native copper, in dense reddish gossan with infillings of crystalline calcite, appeared near the water. Mr. Walsh informed me that a small seam of secondary sulphides passed into the footwall at 50 ft., and several other streaks below water-level in the footwall are to be prospected for by cross-cutting. Chalcopyrite and pyrite stained by earthy chalcocite first came in, 3 to 4 ft. wide, at 56 ft. depth, under barren pyrite, seams of which were found on farther sinking overlying rich ore. Pyrite is especially in evidence towards the shaft bottom, where two seams of ore, separated by 2 ft. of country rock, can be seen; the northern one, 5 in. thick is of pyrite, and the southern 6 to 12 in. thick, is of cupriferous pyrite, richer at the eastern than at the western end.

The ore cuts out in the face of the western drive on the 50 ft. level but continues under foot.*

The country rock is a granular green slate, showing internal slickensides due to crushing near the hanging wall. In the formation the rock is black and chloritic.

In the northern pothole little copper was found.

The 32 ft. shaft is believed to be on a hanging-wall lode 20 ft. back from that being exploited in the main shaft. This is to be tapped by a crosscut from that shaft at the 100 ft. level. The Warden reported, in January, 1905, that the shaft was being sunk vertically to cut the ore-body at water-level.

* Press reports state that 15 in. of ore was broken down in the western drive at the 104 ft. level, and that a body of ore was struck in the sump at 115 ft. level.

Marabah (M.L. 294).

Location, Etc.

The Marabah adjoins the Pioneer Chief on the east.

Its area is 10 ac. Deserted and not inspected. The ground was first held as the Open Sesame, during 1905.

Development.

One shaft has been opened to a depth of 22 ft. near the centre of the lease on the line of strike of the Pioneer Chief, here 2 to 3 ft. wide.

Output.

1904 ... 23 tons shipped by Price from the Open Sesame, etc.

Primrose (Extd. M.C. 267).

Mgr., Long.

Location, Etc.

The Primrose is located on the west-north-western flanks of Mount Finish, between the Pioneer Chief and the blast furnace on Mount Start.

Its area is 1,600 ft. by 350 ft. The ground had been deserted for some time in October last.

Development.

The main shaft, which is 30 ft. deep, lies 10 ch. south 6° east from the Pioneer Chief; another, 10 ft. deep, lies 1 ch. to the west, and the ground has been scratched for a chain beyond it. Besides these there are old trenches, 5 ch. south-east of the shaft.

Output.

1906 ... 2 tons at grass
4 ,, ,, carrying 10 % copper.

Ore-bodies.

In addition to the main ore-body there appear to be several small detached masses of ore on the lease. The country rock is a granular schist, with much sinter adjacent to the footwall of the ore-body.

The main shaft exposes a vein of quartz 15 in. thick, striking west 8° south and dipping 2 in 1 southwards, but cutting out in the western end. A little over 2 tons of ore is bagged at the shaft, but some of it may have come from other crops on the claim. The seconds, amounting to 4 tons, comprise quartz, quite 70%, cellular gossan and dense limonite with malachite and a little chalcopyrite; they contain perhaps 10% copper.

Nothing has been proved in the western shaft, which is too far to the north.

The trenches to the south-east expose veins of quartz 2 in. to 12 in. thick, in stained speckled schist, with bunches of poor carbonate ore but nothing of value.

Try Again (M.L. 318).

Mgr., Matheson.

Location, Etc.

The Try Again lies ¼ mile south of the Pioneer Chief, on the track from that mine to the blast furnace on Mount Start.

The area is 5 ac. The lease is the property of the Willcocks Cloncurry Development Syndicate, who have, however, done no work on it.

Output.

1904 ... 25 tons shipped.

Literature.

For title of report, numbered as below, see Introduction.

(8) Mr. Gibb's report contains the following analyses (Government Analyst):—

(s) Ore selected for shipment—

Copper	=	36·7 %
Silica	=	6·1
Iron protoxide ...	=	23·9
Alumina	=	1·4
Lime	=	tr.
		68·1

(p) Pyritic ore—

Copper	=	46·6	
Silica	=	2·0	Gold = trace
Iron protoxide ...	=	25·0	Silver = trace
Alumina	=	1·1	
Sulphur	=	10·1	
		84·8	

(r) Rejected ore—

Copper	=	20·9 %
Silica	=	29·4
Iron protoxide ...	=	23·4
Alumina	=	4·1
Lime	=	0·4
Sulphur	=	0·7
		78·9

Easter Gift (M.L. 290).

Mgr., Webb.

Location, Etc.

The Eastern Gift lies 1 mile east of the blast furnace on Mount Start, and just to the west of the newly laid out township of Marabah.

The area is 5 ac. Deserted at time of visit, in October, but evidently lately worked.

Development.

There is a collapsed shaft in the north-western corner of the lease, but the last work was done in a shaft 3 ch. west-south-west of the north-eastern peg. This shaft has been filled to within 15 ft. of the surface, with mullock from a stope at the western end. The only other opening is a trench, on the western boundary, now washed in.

Output.

1906	...	6 tons	shipped	reported to carry 40 % copper
		2 ,,	at grass	carrying 40 % copper
		15 ,,	,,	,, 20 % ,,
		3 ,,	,,	,, 10 % ,,

Ore-bodies.

The crop, which strikes east 5° north and dips 3 in 1 h. to the south, is marked between the shafts by fragments of cellular quartz. At the western shaft very siliceous cellular and granular hæmatite has been thrown out. A chain to the west quartz again crops, and on the western boundary of the lease limonite in quartz with crystalline malachite and tesselated chalcopyrite has been found by trenching. Some ore has been shipped from here, and 3 tons of seconds, rich in iron but also carrying 25% silica and running between 10% and 15% copper, remain at grass.

In the eastern shaft the lode is ill defined, especially on the hanging-wall, joints in which are much stained by azurite. It appears to cut out in the eastern end of the shaft, but, in the upper part of the stope at the western end, can be seen 18 in. azurite-bearing gossan, with secondary silica, the latter both crystalline and, towards the hanging-wall, in the form of brown chalcedonic chert. The ore at grass comprises chalcocite, tile-ore, chrysocolla, malachite and azurite. The firsts, of which there are 2 tons bagged at the mine, are believed to have averaged 40% and the 15 tons of seconds in the paddock should yield 20% copper.

The country rock is the nearest approach to a grey siliceous slate seen on the field. Developments scarcely allow of certainty as to the origin of the ore-bodies but the occurrence of hæmatite is suggestive of regional metamorphism.

Woomera (M.L. 302).

Mgr., Matheson.

Location, Etc.

The Woomera lies 30 ch. north-north-east of the Pioneer Chief.

Its area is 10 ac. It is the property of the Willcocks Cloncurry Development Syndicate, which is, however, doing nothing with it.

One shaft has been sunk in the north-eastern corner, but has caved in.

Ore-body.

The ore-body is understood to strike east and west.

Noontide (M.L. 239).

Mgr., Matheson.

Location, Etc.

The Noontide lies 10 ch. west of Cone Creek, ½ mile north of Duck Creek, and ½ mile north-west of the blast furnace on Mount Start. The country is very low and flat, being liable to flooding from Cone Creek.

The area of the lease is 20 ac. The lease is the property of the Willcocks Cloncurry Development Syndicate, which, however, is doing no work here.

Development.

A shaft, No. 1, has been sunk in the north-western corner of the lease to a depth of 22 ft., but, with the stopes, has now collapsed, leaving a cavity 20 ft. long, 10 ft. wide and 12 ft. deep.

Another hole, 15 ft. deep, lies 2 ch. to the west-by-south of this shaft, just outside the present boundary.

A third shaft, 12 ch. to the east-by-south of the first, is 30 ft. deep, and is now partly flooded.

A fourth shaft, originally 40 ft. deep but now fallen in, lies 5½ ch. to the east of the third. Besides these workings, there are several shallow potholes in this, the eastern, part of the lease.

Output.

		22	tons	shipped	by Sandelin Mac von and Milchurch, containing 15 % copper (Report)
1904	...	17	,,	,,	,, Boyd and Absolon, containing 30 % copper (Report)
1904	...	23 19/20	,,		(Warden's return)
		62 19/20			
1906	...	15	,,	at grass	carrying 15 % copper
		5	,,	,,	,, 10 % copper.

Literature.

For title of report, numbered as below, see Introduction.

(8) Mr. Gibbs gives the following analyses (Government Analyst):—

(r) Rejected (three-fourths) from the ore raised—		
Copper	=	11·0 %
Silica	=	41·8
Iron protoxide	=	19·6
Alumina	=	2·2
Lime	=	4·0
Sulphur	=	0·6
		79·2
(w) Whole reef—		
Copper	=	24·8
Silica	=	25·8
Iron protoxide	=	23·0
Alumina	=	2·1
Lime	=	tr.
Sulphur	=	0·3
		76·0

Ore-bodies.

The crop between the two western shafts strikes west 13° south, the ore-body dipping 70° to the south by east; between the eastern and western workings its strike is east 7° south; and between the two eastern shafts its strike is east and west.

The ore in the western shaft just outside the lease is siliceous, veined by malachite and impregnated by chalcocite. About 1 ton of 20% ore was got here.

At the western end of the hole on the site of No. 1 shaft, where the country is a granular chloritic schist, a formation of the crushed rock and lenticular quartz, 2 ft. in total width, is exposed, but at the eastern end there is only 12 in. of crushed schist with little or no quartz. The faces are very poor, and the shaft must have been sunk on a bunch of limited horizontal extent. It is reported that 22 tons of 15% ore were shipped from this shaft by the original prospectors, and 15 tons of ore are now paddocked near by. My sample from the heap consists of: dense earthy turgite with impregnations of chalcocite (glance) and veins and minute bunches of malachite, the last generally surrounded by an aureole of barren turgite; quartz and quartzose ore veined and stained with malachite, the quartz, even where crystalline, showing indications of schist incompletely replaced; and siderite splashed through with metallic glance (a most unusual occurrence) and altering into turgite. The silica contents is probably below 5%. The following is the result of assay (Government Analyst):—

Copper	=	15·5 %
Gold	=	trace (less than 9 gr. per ton)
Silver	=	4 dwt. per ton.

This comparatively low result proves that there is very little cuprite present in the earthy turgite.

No. 3 shaft appears to have been sunk on a barren quartz and cupriferous schist formation 3 ft. wide. The 5 tons of ore, stacked at the shaft, are reported to have come from near the surface. It is ferruginous, but also very siliceous, and probably does not carry more than 10% copper. The quartz fragments are set in a dark siliceous matrix impregnated with chalcocite and malachite. This secondary silica is younger than the chalcocite, which it surrounds, but older than the malachite, which occurs crystallised in minute cavities lined by quartz crystals.

No. 4 shaft is reported to have produced 17 tons of 30% ore.

Alabama (M.L. 304).

Mgr., Matheson.

Location, Etc.

The Alabama lies 4 ch. south of the Noontide.

Its area is 5 ac. This is the property of the Willcocks Cloncurry Development Syndicate, which, however, is doing nothing here, the manager's reports published under the heading of Alabama referring to the Belfast.

Two shafts have been sunk near the northern boundary, one near the centre, the other in the north-eastern corner. They have both caved in.

Ore-body.

Quartz crops at the surface striking east 5° north.

Blue Bell (M.L. 609).

Mgr., Condon.

Location, Etc.

The Blue Bell is located 5 ch. north of the Noontide.

Its area is 5 ac. The leaseholders were not present at the time of my visit, but had only just knocked off work.

Development.

One shaft is being sunk, and at the time of my visit was 20 ft. deep. From it an opencut extends 20 ft. to the east.

Ore-body.

The strike of the ore-body, which apparently is in a crush-zone, is east 12° north, and the dip is 5 in 1 to the south. It has been traced by shoads for 3 ch. to the east of the shaft, and may possibly yet be proved to be a continuation of the Pioneer Chief.

In the cut near the shaft the body is 12 in. wide, and in the upper part of the shaft it is from 9 in. to 12 in. wide, but in the lower part another stained band is coming in, making the total thickness 2 ft. It comprises gossan, quartz and altered schist, in which occur nodules of mixed chalcocite and tile-ore, up to 9 in. in diameter, together with

much sinter, but it is free from included quartz. The ore at grass comprised: 5½ tons bagged and estimated to carry 40 % copper, and 2 tons ready for bagging.

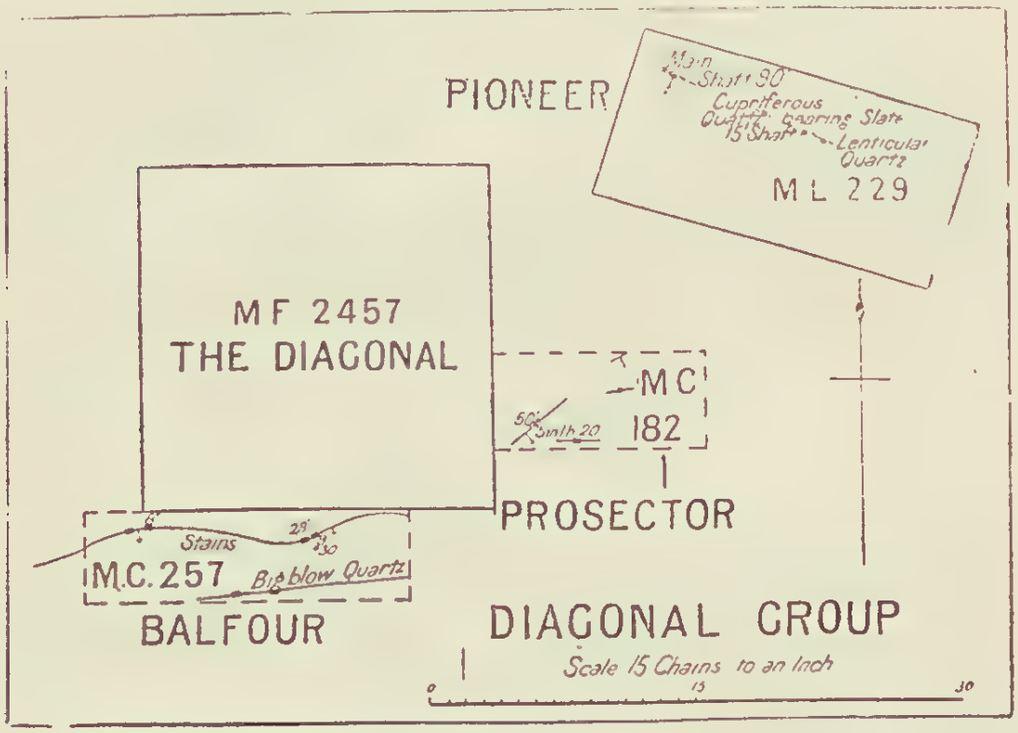
The country rock is a jointed chloritic schist, rendered very schistose along the narrow zone in which the ore occurs.

Output.

1906 ... 7½ tons at grass carrying 40 % copper.

DIAGONAL GROUP.

The Diagonal Group takes in leases and claims surrounding the freehold (2457) and all on distinct ore-bodies making insignificant crops—the Pioneer, Alone Hand, Prospector, and Balfour.



Pioneer (M.L. 229).

Mgr., Matheson.

Location, Etc.

The Pioneer is situated on the southern side of Duck Creek, about one mile west of the blast furnace on Mount Start, which is 22½ miles south-south-west of Cloncurry.

The area is 20 ac. The lease is the property of the Willcocks Cloncurry Development Syndicate.

Development.

The main shaft lies 3 ch. south-south-east of the north-western corner of the lease. The shaft is 8 ft. × 4 ft. in the clear. It was

sunk 40 ft. (5 ft. below water level) by the first holders and the syndicate has deepened it to 90 ft.,* the underlie being 6 in 1 h. to the south below a depth of 30 ft.

An open-cut, 15 ft. deep, runs 6 ft. east and 40 ft. west of the shaft.

At 6, 8, 8½ and 9½ ch. east of the shaft potholes have been opened on the line, the second last being 15 ft. deep, and stoped for 10 ft. to the east.

The mine was idle when visited, but a pump had lately arrived on the ground and it was proposed to start work again shortly.†

Literature.

For title of report numbered as below *see* Introduction.

(8) Mr. Gibb's report contains the following analyses (Govt. Analyst):—

(l) Left in reef—		(r) Rejected from ore raised—	
Copper	= 18·9	Copper	= 17·5
Silica	= 33·5	Silica	= 39·1
Iron protoxide ...	= 23·1	Iron protoxide ..	= 19·9
Alumina	= 2·1	Alumina	= 3·9
Lime	= 2.6	Lime	= 0·4
Sulphur	= 0·7	Sulphur	= 0·6
	80·9		81·4

Output.

1904	... 26	tons shipped
1906	... 10	,, ,,
Total	36	,, ,,
	30	,, at grass (Oct., 1906).

Ore-body.

The strike of the ore-body by the workings is west 25° north and the dip is southwards. The country rock is chloritic schist, the strike of which in the western end of the open-cut appears to be east-north-east. The hanging-wall country is much slickensided internally, wherefore the ore-body would seem to be on a crush zone.

The ore-body in the main shaft is reported to have averaged 8 to 10 in. in width, but at 30 ft. below the surface a schistose formation is stained and impregnated over a width of 18 in. with malachite and tile ore. The underlie of the shaft below 30 ft. was necessitated by a flat break, the lower part of the ore-body being 6 ft. to the south. Above the water-level (at 35 ft. depth) the ore is chiefly limonite, with tile-ore, malachite and some azurite, quartz being very plentiful, and the copper content 10 to 15%. Below the water-level the chalcopyrite is thinly coated in all crevices by earthy

* The Warden in Jan., '07, gave the depth as 114 ft.

† From Press reports it is learnt that the pump started work in November, 1906, and unwatered the shaft in one day, but the manager makes no mention of any further work done.

secondary sulphide and the ore raised from the shaft bottom is chalcopyrite with chalcocite, both dull and metallic, the copper content being 40%. There is about 30 tons of ore at grass, which the manager estimated would carry 24% copper. My sample of this consists of schist stained by malachite and iron oxides and carrying some chalcopyrite as well as impregnations of chalcocite, cellular gossan; and limonite with radiating malachite, and impregnations of chalcocite, as shown by its metallic streak, where not otherwise distinguishable. The Government Analyst returns:

Copper	...	...	= 18·9 %
Gold	...	...	= 1 dwt. 4 gr. per ton
Silver	...	...	= 11 ,, ,,

A formation 3 to 4 ft. wide of slate and quartz with tile ore and malachite in the interstices is exposed in the first hole to the east of the shaft. The ore as a whole will not run much above 5% in copper.

In the 15-ft. hole there is 2 ft. 6 in. to 3 ft. of a confused formation, slightly iron-stained and containing occasional spheroidal bunches of glance, up to 6 in. in diameter. The hanging-wall shows slickensides, proving this to be still in the crush-zone. Towards

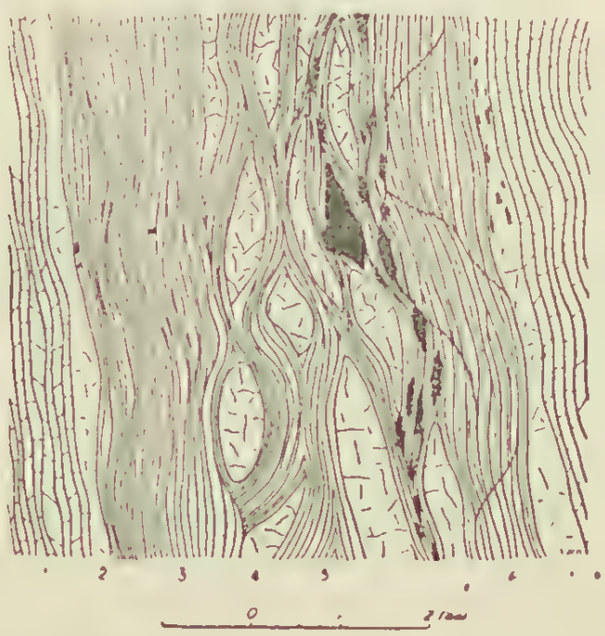


FIG. 15.—SECTION ORE-BODY, EASTERN END 15-FT. SHAFT, PIONEER.

1. *Slate*
2. *Gossan and quartz*
3. *Schist*
4. *Quartz lens*
5. *Crushed schist (cupriferous, where shown black)*
6. *Internally slickensided schist*
7. *Ironstained quartz*
8. *Slate.*

the shaft bottom the quartz-bearing crushed schist formation is 2 ft. 6 in. wide and is slightly cupriferous for 6 in. from the hanging-wall

Two 3-in. bands of gossan and quartz in the foot- and hanging-walls respectively are separated from the main formation by 18 in. and 9 in. of schist. (Fig. 15.)

The easternmost hole apparently was opened on lenticular quartz veins, but some siliceous 10% ore has been raised here.

Alone Hand (M.L. 230).

Mgr., Wilmot.

Location, Etc.

The Alone Hand lies a few chains south-east of the Pioneer.

Its area is 5 ac. It was not visited by me, as it was understood to be abandoned.

Development.

One shaft has been sunk.

Output.

1904	...	34	tons shipped, carrying 35 % copper
1905	...	$1\frac{12}{20}$	,, ,, by Wilmot.
Total	...	$35\frac{12}{20}$	,, ,,

Diagonal (M.F. 2457).

Location, Etc.

The Diagonal lies 1 mile west-south-west of the blast furnace on Mount Start, on flat country adjacent to the flood plain of Duck Creek.

The area is 40 ac. The freehold has lately passed from the hands of Mr. A. Coats to the Queensland Copper Freeholds, Ltd. The property was deserted in October last, and, not yet having been re-marked, there was much doubt as to its exact location and extent.

Development.

The main workings are in about the centre of the freehold. They comprise only potholes and trenches, all in a collapsed state. A number of other potholes were seen, there being several in the north-western corner.

Literature.

For title of report numbered as below *see* Introduction.

(2) Mr. Jack did not inspect the Diagonal, but refers as follows to the selection adjoining it on the west:—

In the selection numbered 2458 (2 miles W.N.W. of the Chinaman's) I saw two lodes. The first runs west 10 degrees south, is well defined, and about three feet wide, with a dip to south 10 degrees east at 75 degrees. Besides green carbonate of copper and some hæmatite iron ore, a good deal of very fair grey ore is visible. This is a sound payable lode. A second lode parallel to that last described is said to occur in the same selection, but we were too pressed for time to visit it.

A hundred yards to the south, still in the same selection, is a third lode with two quartz reefs running to the S.W. A considerable quantity of green carbonate of copper is visible on the surface of the lode. The country is chlorite slate and greywacke, turned up on end and having a strike to W.S.W.

(7) Mr. Rutherford reports:

Three quartz outcrops were examined on this area, all running more or less parallel in an east-north-east—west-south-west direction. The middle outcrop can be traced for 50 yds. The quartz is hard and unpromising looking, and lies in schist. From an irregular excavation 18 yds. long on the line of outcrop and 6 ft. deep, 17 tons of rich ore are said to have been removed. An examination of this hole shows that it has contained a lenticular pocket of ore lying in the bedding of the schist and completely cutting out on all sides. Continuing to the west a similar excavation 30 ft. long and 4 ft. deep shows where a second bunch of ore has been removed. The farthest south of the outcrops shows well defined on the surface, but a trench 6 yds. across shows the quartz to be lying on the surface in shallow foldings of the schist. . . . The farthest north of the outcrops shows for a distance of 43 yds. stained in places with green carbonate. . . It is possible that these two outcrops, if further prospected, may be found to contain small pockets of ore similar to those found in the middle outcrop.

ORE-BODIES.

Two main ore-bearing zones have been tried on this freehold, but a number of others are to be seen on which little or no work has been done. The country being flat and covered with quartz rubble, still others may yet be discovered.

The northernmost consists of lenticular quartz-bearing schist, with interstitial malachite, tile-ore and glance, the copper ore in some parts forming bodies 2 ft. thick and at the best averaging 15% copper. It has been traced for a distance of ½ mile, but has been opened only by potholes at irregular intervals, though worthy of a little more attention. The country rock is chloritic schist, of which the strike is east 38° north and the dip 85° to the south-east.

The southern zone can be followed for nearly 20 ch. from the Prospector boundary to the west-south-west, there being quartz crops up to 5 ch. in length and 18 in. to 10 ft. across, between which trenches have proved from 6 in. to 2 ft. of cupriferous gossan, of a promising appearance, more especially towards the west.

Prospector (M.C. 182).

Mgr., Sandelin.

LOCATION, ETC.

The Prospector lies ¼ mile south-south-west of the Pioneer, and adjoins the Diagonal on the east.

The area is 800 ft. × 350 ft. In October last it was being worked on tribute.

DEVELOPMENT.

The main shaft, 50 ft. deep, is in the south-western corner of the claim; a drive runs south-west for 15 ft. at the bottom, just above water-level. This drive is to be continued 50 ft. and at the same time overhead-stoping will be carried on. Another shaft, 20 ft. deep and inaccessible, is 2½ ch. to the east-south-east. Trenches run 10 ft. east and west of this shaft, and an old trench lies 1 ch. to the west. A pothole has been opened 5 ch. east-north-east of the main shaft. Old trenches lie on the boundary 2 ch. north of the pothole; one is 10 ft. deep and they extend over a total length of 50 ft.

Output.

1906 ... 10 tons in transit, Oct., 38 to 42 % assays.
20 ,, at grass, 30 % copper

Ore-Bodies.

There are four separate outcrops within this claim, none of them striking in quite the same direction, and perhaps representing four separate crush-zones.

That at the main shaft strikes east 40° north dipping 5 in 1 h. to the south-east. Ore can be traced for 25 ft. to the south-west of the main shaft, and gossan and quartz show at the surface for 30 ft. further. In the shaft the ore in the north-eastern end is only 3 in. wide from top to bottom, but varies in thickness between 9 in. and 15 in. in the south-western end, being 20 in. wide at 40 ft. beneath the surface. The body pinches to 2 in. in width in the face of the drive, but is 18 in. wide nearer the shaft and further work may reveal another bunch. The ore consists of dull amorphous chalcocite and the crystalline form known as glance, of malachite, chiefly encrushing, of tile-ore in limonite, gossany in part, and of chalcopyrite, which appeared first in small quantities at 35 ft. below the surface. The amount of quartz is increasing in the lower part of the shaft. The drive exposes gossan with quartz and malachite carrying bunches of chalcocite. A few limy floors or horizontal joints, generally considered specially favourable for the occurrence of rich ore, were noticed in sinking the shaft.

The country rock at the main shaft is schist, that of the footwall being more jointed and less crushed than that of the hanging-wall, but there is a persistent 3 in. band of kaolinised flucan on the former, while flucan is seen only in some places on the hanging-wall, just within which, however, is a polished face. The flucan seems to have influenced the precipitation of the copper ores, more especially the malachite, though, in the face of the drive, the irregular nodules of chalcocite are more abundant adjacent to the footwall flucan than in the gossany formation towards the hanging-wall. The above evidence points to these ore-bodies being on a remarkably well-defined crush zone. There are 8 tons of 30% ore at grass and 3 or 4 tons of 20% seconds.

The pothole 5 ch. east-north-east of the main shaft exposes 18 in. of quartz and limonite running east 10° north. Some copper ore has been taken from here and the indications warrant further sinking. This body may possibly be in the continuation of the zone worked in the main shaft, though off the direct line of strike. The country rock is schist, dipping steeply to the south.

The trenches on the northern boundary are on ore-bodies, striking west-south-west and underlying south-south-east. The ore consists of malachite and tile-ore, and the last lot shipped ran 30%

copper. These bodies are nearly on the line of strike of the crush-zone at the main shaft.

The strike of the ore-body in the southern shaft is west 5° north, and if continued it should intersect the main ore-body within a few chains to the south-west of the deep shaft. It dips steeply to the south. The ore-body is 15 in. wide, but it carries much quartz and all energies are therefore concentrated for the present at the main shaft. The firsts paddocked, 6½ tons, contain 37% copper and the 3 or 4 tons seconds carry 20% copper with 50% silica.

Another crop, not included in any holding, lies 5 ch. south-west of the southern shaft on the Prospector.

Balfour (Extd. M.C. 257).

Mgr., Johnson.

Location, Etc.

The Balfour lies between the Diagonal freehold on the north and the Mountain Maid lease on the south.

The area is 1,200 ft. × 350 ft.

Development.

The underlie shaft 10 ft. long and 6 ft. wide, 6 ch. from the north-eastern corner and 1½ ch. from the Diagonal boundary, is 28 ft. deep, the inclination being 3 in 1 h.; 20 ft. to the east-north-east is a pothole 9 ft. deep; and 50 ft. to the south-east a vertical shaft has been sunk 30 ft. Two other holes, 1 ch. apart and 8 ft. deep, have been opened 9 ch. to the west. One other shaft has been sunk 12 ft. but has now caved in; it is 5 ch. south-east of the main underlie and on the southern outcrop.

Output.

	12	tons shipped, carrying 36 % copper. (*fide* Mr. Johnson)
1906 ...	2$\frac{4}{20}$	tons shipped by H. Johnson
Total	14$\frac{4}{20}$	

Ore-Bodies.

Two separate crush-zones crop on this claim. The southern comprises large blows of quartz and sometimes of schist, striking east-north-east. The one shaft opened on this zone proved a lenticular body of quartz, with cupriferous gossan of no promise.

The northern line is 3 ch. distant from the above. Its general strike is east-north-east, but it has been bent much out of its course to the south at the main workings. This crop extends right through the claim.

The easternmost pothole is in formation, as is the main underlie shaft, which exposes of the whole width only the 6 ft. adjacent to the

hanging-wall near the surface and the same width adjacent to the footwall at the bottom. The dip of the footwall at the bottom is 1 in 1, wherefore, if the walls remain parallel and with this dip, the total width of the formation should be over 15 ft. The country rock is chloritic schist, produced, like the formation, by the crushing due to earth movements. The formation is made up of lenticular bodies of quartz (one, on the footwall at the shaft bottom, is 4 ft. thick), in altered and crushed schist, the last strongly stained by malachite and azurite and carrying bunches of tile-ore and glance, the whole averaging perhaps 10% copper. The silica content is high, but the shaft should be continued, as the gossany nature of the ore is indicative of copper having been leached, and most likely downwards.

There are at grass 2 tons of firsts, my sample of which consists of: schist, replaced by malachite and glance between small quartz lenses; ferruginous kaolin, containing some chalcocite; dense limonite, minutely veined by and impregnated with chalcocite and malachite; chalcocite, with crystalline malachite forming irregular cellular masses; and fairly pure fibrous malachite. The following is the result of assay (Government Analyst):

Copper	... ...	=	38·6 %
Gold	... ...	=	20 gr. per ton
Silver	... ...	=	5 dwt. 14 ,, ,,

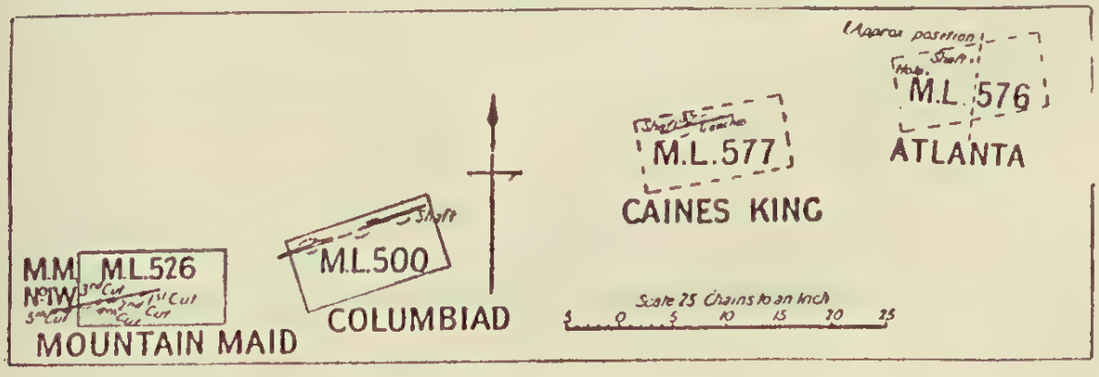
The 5 tons of seconds at grass should average 16% copper, and the whole mullock tip, say 100 tons, will run 2% copper.

The first hole to the west of the main underlie shaft exposes 4 ft. of ferruginous quartz on the footwall, and 3 ft. of malachite and quartz on the hanging-wall, worth sinking on, though apparently contracting in depth. This has produced 1 ton of 36% ore.

In the western hole the formation is still cupriferous, but has pinched down to a few inches. It can, however, be traced to the boundary of the claim, 3 ch. distant, and for several chains beyond.

COLUMBIAD GROUP.

The Columbiad group comprises the Mountain Maid, Mountain Maid West, Columbiad, Caine's King and Atlanta. The leases are on one long crush-zone, marked by strong siliceous crops, over a distance of a mile.



Mountain Maid (M.L. 526).

Mgr., Johnson.

Location, Etc.

The Mountain Maid lies south of the Balfour and 1¼ mile south-west of the blast furnace on Mount Start.

The area is 10 ac. The lease was idle in October last, having lately been placed under option, with the Columbia and Caine's King.

Development.

The workings comprise four open-cuts. No. 1 cut, 20 ft. long, is near the centre of the lease; No. 2 cut, 20 ft. in length, is 3 ch. to the west; No. 3 cut, only 3 ft. in length, is 10 ft. further west; and No. 4 cut, 6 ft. long, is 1 ch. beyond.

Ore-bodies.

The Mountain Maid crop, which is about 12 ch. south of the Balfour, is a very prominent one, beginning at 5 ch. from the eastern boundary of this lease and continuing without a break for 2½ ch. into the No. 1 West. The eastern part is 24 ft. across, and rises 6 ft. to 15 ft. above the general level of the ground. The strike is east-north-east and the dip 5 in 1 h. to the south-south-east. Several small patches of chalcocite and malachite have been located near the eastern extremity of the blow, but the outcrop as a whole is not a very kindly one, iron being present in only small amounts.

No. 1 cut exposes, beginning at the east: 5 ft. of decomposed ironstained rock; 3 ft. malachite-stained material; 4 ft. somewhat gossany granular quartz; 3 ft. slightly copper-stained granular quartz; 3 ft. ferruginous quartz and schist and 18 in. green-stained quartz. My sample, taken from over a width of 18 ft in the cut, consists of: black schist, slightly stained by malachite; granular quartz, replacing schist and lined on cracks with malachite; crystalline quartz, coated with malachite; cellular limonite; and earthy gothite, carrying crystalline malachite. The following is the result of assay (Government Analyst):

Copper	...	...	= 4·3 %
Gold	...	...	= trace (less than 9 gr. per ton)
Silver	...	...	= ,, (,, ,, ,,)

No. 2 cut exposes schists, partly replaced by granular quartz slightly stained by malachite, and expected to average 10% copper over a width of 20 ft., but not likely to improve much beneath the surface.

No. 3 cut, which has only just been commenced on the southern side of the crop, exposes only copper-stained rock.

No. 4 cut, also on the eastern side of the crop, exposes schists with lenticular quartz veins and a 12 in. body of gossan worth sinking on, as likely to improve. The whole 6 ft. visible may average 1% copper.

Mountain Maid No. 1 West (M.L.)

Mgr., Conors.

Location, Etc.

The No. 1 West adjoins the Mountain Maid on the west.

The area is 5 ac. The ground was not manned, being exempt, when inspected in October last.

The only work done is an open-cut, 2½ ch. west of the Mountain Maid boundary. It is 30 ft. in length and 7 ft. deep.

Ore-body.

The Mountain Maid crop in this lease rises 15 ft. above the flats. The cut exposes schist, in great part replaced by quartz, leaving only scattered flakes of chlorite. The whole is very poor, the inner 12 ft. of the cut being almost entirely quartzite, but, for 8 ft. to the east of that, schist and quartzite are ironstained in parts and carry a little malachite, averaging perhaps 1% copper.

Columbiad (M.L. 500).

Mgr., Baker.

Location, Etc.

The Columbiad lies a few chains east-north-east of the Mountain Maid.

The area is 10 ac. No one was on the lease when visited in October last, the lease being under exemption.

Development.

The only excavation of any extent is a trench, 10 ft. long and 2 to 5 ft. deep, on a low hill in the eastern part of the lease. It is intended to sink a shaft 14 ch. to the west.

Ore-bodies.

The Mountain Maid crop continues into this lease for several chains, when there is a blank and then a crop for 7 ch. again. The

crops rise 10 ft. above the ground and crown low hillocks, or ridges, 10 ch. apart, the eastern one having an elevation of 50 ft. above the flats. In the western part of the main crop only one or two small patches of copper ore have been noticed and removed; but on the slope of the hillock, 2½ ch. to the south of the summit, a patch of a few tons of malachite, tile-ore and chalcocite has been found in a ferruginous quartz crop. This should be sunk on, though probably only an isolated bunch.

The trench on the eastern hill is in a quartzite crop 7 ch. long up to 1 ch. wide and rising 10 ft. out of the ground and showing a little gossan in the northern part. The exposure consists of schist, partly ironstained, and quartz, about 18 in. of the latter in the centre of the cut carrying at least 25% glance, and the whole being stained by malachite, so that the full 10 ft. width should average 5% copper. There are at grass 5 tons of ore containing at least 15% copper, and the refuse amounts to an equal quantity. A shaft should be sunk here and cross cuts opened.

Caine's King (M.L. 577).

Mgr., Baker.

Location, Etc.

Caine's King lies about ½ mile east-by-north from the Columbiad, half-way between that lease and Duck Creek.

Its area is 10 ac. It was exempt and deserted when visited in October last.

Development.

The workings comprise a vertical shaft, 30 ft. deep, at the western end of the crop; a trench (*a*), 6 ft. long, 1 ch. to the east; a trench (*b*), 10 ft. long, 1½ ch. further east; and a trench (*c*), 10 ft. long, 1½ ch. still further east.

Output.

1906 ... 2 tons shipped, containing 23 to 24 % copper (*fide* Mr. Johnson).

Ore-bodies.

The chief crop, which strikes east 10° north, is 6 ch. in total length, and has a width of from 10 to 15 ft., there being a second crop, 2 ch. long, ¼ ch. to the east. It consists of schistose quartz, much of it as interlocking crystals, as at the Tharsis. That it replaces a crushed schist is indicated by thin lines of chlorite. It is slightly iron-stained and occasional patches of gossan and malachite are to be seen, but there is very little rich ore, and no large body even of medium grade.

The eastern crop, which rises 5 ft. above the adjacent flats, is quartz with traces of copper.

At the northern end of the main crop malachite is showing in the quartz; and the trench (*c*) exposes both malachite and azurite with a little chrysocolla in quartzite, the average grade of which however is low.

Much gossan shows at the surface to the south of this trench, occurring with quartz, in one place over a width of 10 ft. This crop is worth sinking and testing for copper at a depth, from which the whole body could be developed.

The trench (*b*) has been opened on a small patch of malachite-bearing ore of no extent.

Trench (*a*) proved only ferruginous and cupriferous schist.

The shaft is being sunk to meet the lode on the underlie, being 10 ft. below and 15 ft. south of the cap which rises 20 ft. above the neighbouring flats.

Occasional bunches of ore were met and between 2 and 3 tons of 23% ore have been shipped. The 6 tons seconds at grass are made up of schist and quartz with malachite and azurite, and they should average 15% copper.

Atlanta (M.L. 576).

Mgr., Baker.

Location, Etc.

The Atlanta lies $\frac{1}{4}$ mile east of the Caine's King and about $\frac{1}{2}$ mile south-west-by-west of the blast furnace on Mount Start. The workings are alongside the Duck Creek-Boulia road.

Its area is 12 ac. The ground was until lately held as the Keystone (M.C. 253).

Development.

The workings comprise an inaccessible shaft, 20 ft. deep, with a crosscut 4 ft. south $\frac{1}{2}$ ch. west of the road, and a pothole, 4 ft. deep, 3 ch. to the west of the shaft. This work was done by the former claim-holders.

Output.

1904	...	2	tons shipped by Baker
1906	...	$3\frac{2}{20}$	tons ,, ,, Absolon (source doubtful)
		$5\frac{2}{20}$	,,

Ore-bodies.

A quartzose outcrop extends from the road for 4 ch. to the west, and in it are small irregular bodies of tile-ore and malachite, one of

which, struck in the shaft, yielded 3½ tons of 40% ore. The ore consisted of glance in quartz stained by malachite, and was accompanied by much sintery lime-magnesia carbonate.

CHINAMAN GROUP.

The Chinaman crush-zone has been traced a distance of 2½ miles and besides the freehold three leases and two claims have been pegged out.

Chinaman (M.F. 2453).

Location, Etc.

The Chinaman freehold lies 1 mile south by east of the blast furnace on Mount Start and extends eastwards from the banks of Duck Creek for 34 ch.

The area of the freehold is 58 ac. At the time of my visit it was deserted, being the property of Messrs. Coats and Robertson. It has now been taken over by the Queensland Copper Freeholds, Ltd.

Development.

The extreme western workings, which are within 3 ch. of Duck Creek and have collapsed, comprised only shallow shafts. A pothole has been opened at 1½ ch. to the east of them. The company's cut which is 30 ft. long and 5 ft. deep, and near the north-eastern corner, was opened 25 years ago. Another small trench opened lately lies 4 ch. to the west.

Literature.

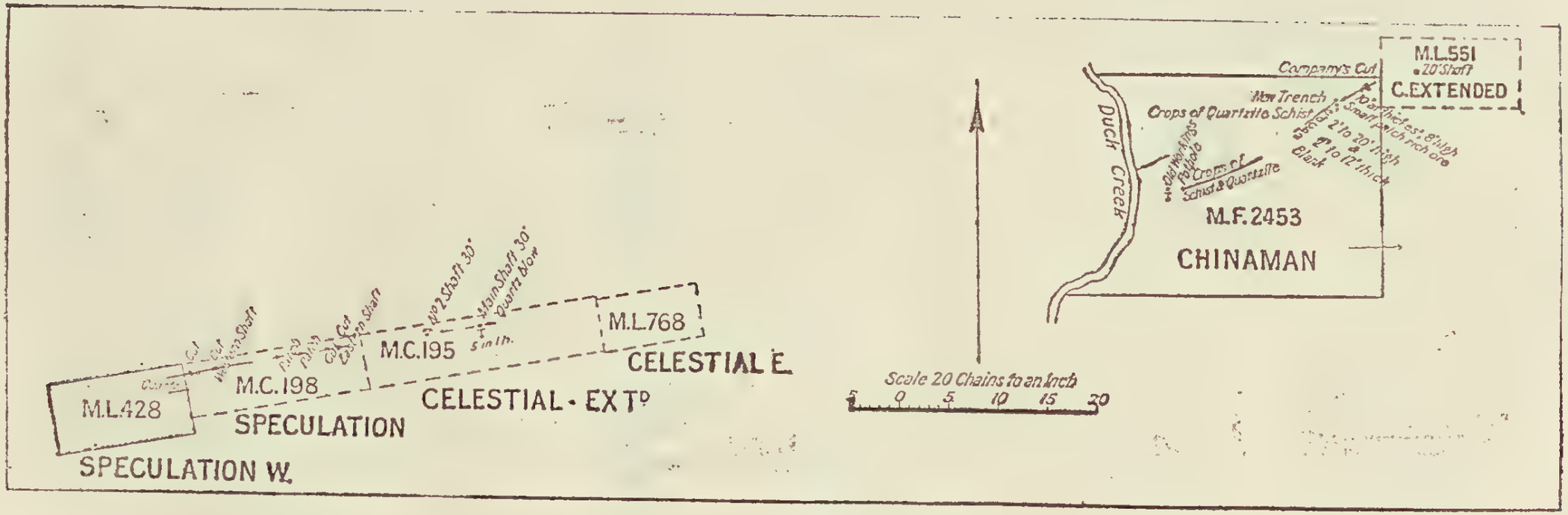
For titles of reports numbered as below *see* Introduction.

(2) Mr. Jack's reference to the Chinaman is as follows:

The Chinaman's Lode occurs on the left bank of Duck Creek, about a mile and a-half S.E. of No. 2459. It runs from west 30 degrees south to east 30 degrees north. It is a quartz reef, standing from 3 feet to 15 feet above the general level, and measuring 17 feet across. It runs for nearly a quarter of a-mile through slate, whose strike is parallel to the lode. The quartz has its cavities coated with green carbonate of copper, and very often the quartz when broken up is found to be intimately mixed with carbonate of copper. Both slate and ore are highly chloritic.

(4) Mr. Cameron added to the above:

Of these lodes, the only one visited was the Chinaman's Lode, as it was the only one on which any prospecting work has been done since Mr. Jack's visit. A trench has been driven across the outcrop near the northern end, and shows about six feet of chloritic ore and quartz, interbedded with slates. A bulk assay of this 6 feet gave 16·36 per cent. of copper, a trace of gold, and 4 dwt. 13 gr. of silver.


M.L.551
20' Shaft
C. EXTENDED
Company's Cut
New Trench
Crops of Quartzite Schist
Duch Creek
Old Workings
Pebble
Crops of Schist & Quartzite
M.F. 2453
CHINAMAN
Scale 20 Chains to an Inch
0 5 10 15 30
M.L.768
M.C.195
M.C.198
M.L.428
CELESTIAL E.
CELESTIAL - EXT.D
SPECULATION
SPECULATION W.

(7) Mr. Rutherford wrote:

This includes an outcrop of friable quartz, associated with schist rising 15 ft. in places above the level of the surrounding country, and traceable for a distance of 350 yds. along the bedding of the schists in an irregular north-east and south-west direction. The only work done consists of a trench across the north end of the outcrop. This cutting shows 5 ft. of schist associated with quartz and impregnated with copper carbonate. This band of schist underlies the quartz outcrop from which undoubtedly the copper has been leached. . . .

Following the outcrop to the south it is seen to follow the foldings of the schist with which it is intimately mixed. In places it measures 17 ft. across, while in others it thins down to 3 or 4 ft. It shows carbonate stains in patches all the way along. I consider this to be not a true outcrop, but a deposition along the bedding of the schist of silica carrying copper in solution. This latter has been leached out to a considerable extent and deposited in the underlying schist. There is little doubt that a considerable quantity of impregnated schist such as is lying at grass, could be got from the western side of the outcrop to a depth of 10 to 12 ft., but otherwise I consider the property of little value.

Ore-bodies.

The Chinaman outcrops extend from the south-western to the north-eastern part of the lease, the general strike being east-north-east and the dip a high angle to the south-south-east. The crops mark areas of silicification and segregation of silica along a crush-zone and their value appears to me to have been much over-estimated presumably owing to the prevalence of green stains of malachite. The zone has not been proved to continue eastwards of the freehold but the Celestial and Speculation (claim) are on its westward extension.

At the western workings a formation of quartz rubble and schist reaches the surface. It is 2 ft. to 2 ft. 6 in. wide and dips 5 in 1 h. to the south.

Beyond the pothole to the east of the old workings, in which gossan is exposed, the crop runs for 10 ch. east 18° north, showing in places as quartzite, in others as schistose quartz and in still others as schist, with thin partings of quartz.

After a blank of 4 ch. quartzite rises like a wall to 20 ft. above the flat and continues north 51° east without a break for 5¼ ch. to the new trench. The quartzite is to some extent lenticular and is divided by longitudinal joints dipping 5 in 1 h. to the south-east. It contains a few rich patches but there is very little copper in the whole mass. The first bulge (*a*) on the plan, is 1 ch. long, 10 ft. high and 10 ft. in greatest thickness; it exhibits only occasional stains of malachite and limonite. The neck (*b*) is ½ ch. long, 2 ft. 6 in. thick and rises only 2 ft. above the ground. The bulge (*c*) is 1¼ ch. long, 10 ft. thick and 10 ft. high; in the southern part there is much schist containing iron and copper ore. The richest part of the crop is that within 6 ft. of the footwall, but this contains at least

50% quartz and not more than 3% copper, though many faces are painted a bright green, owing to a small quantity of malachite having leached out. The copper occurs almost entirely in the schist surrounding lenses of quartz. On the second contraction (*d*), which is ½ ch. long, there is much limonite and some malachite. The last bulge (*e*) is 2 ch. in length; in the central part it is 12 ft. wide; and, in the southern part, where 6 ft. wide, it is comparatively rich in malachite.

The new trench is between the northern extremity of this bulge and another overlapping lens to the east. The copper here also occurs between the laminæ of the schists and in cracks of the quartzite. A small quantity of presumably payable ore has lately been removed.

The crop between the trench and the company's cut, 4 ch. to the east 27° north, rises to a height of 8 ft. and is 10 ft. through at the widest part. It comprises schistose quartzite, with stains and patches of malachite. Two bunches of rich ore have been removed from the southern side of the blow at 1 ch. and 2½ ch. east of the new trench.

The company's cut exposes a footwall of kaolinised slate, dipping 2 in 1 h. to the south. On the footwall is 6 in. barren quartz; next to that is 6 ft. strongly copper-stained schist, with lenses of quartz

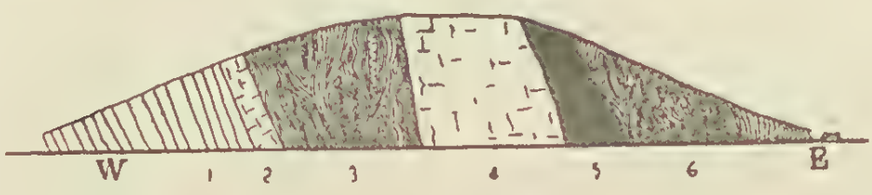


FIG. 16.—SECTION IN COMPANY'S CUT, CHINAMAN.

Scale: 10 ft. to an inch.

1. Kaolinised slate
2. Barren quartz
3. Strongly copper-stained schist with quartz lenses
4. Ironstained quartzite
5. Quartz-bearing gossan
6. Barren quartz and schist.

decreasing downwards in width; then 5 ft. of iron-stained quartzite, increasing downwards; then 18 in. of quartz-bearing gossan also widening downwards; and lastly 6 ft. width of barren quartz and schist. (Fig. 16.) There is stacked at this cut some 40 tons of firsts, chiefly malachite stained schist and quartzite, with lumps of rich ore few and far between It will probably run 10% copper. The seconds, amounting to 3 tons, will not carry more than 3% copper.

The crop extends eastwards for only ½ ch. beyond the cut, but another occurs on the line of strike in the adjoining lease.

Chinaman Extended (M.L. 551).

Mgr., Miller.

Location, Etc.

The Chinaman Extended adjoins the freehold on the east.

The area is 10 ac. Deserted when visited.

Development.

The shaft, which is 20 ft. deep, lies 5 ch. easterly from the Company's cut. It was inaccessible, but is believed to have a crosscut to the south at the bottom.

Ore-body.

The shaft is located on the northern side of a small quartz blow, on the line of the Chinaman crops. The material on the dump from the shaft and crosscut is quartzite, with a little schist, both slightly stained by malachite and containing perhaps 2% copper.

To the north of the shaft there is a strong crop of schist, in which are scattered granules of quartz, giving it the appearance of an amygdaloidal volcanic rock.

Celestial (Extended M.C. 195).

Mgr., Ford.

Location, Etc.

The Celestial lies about 2 miles south-south-west of the blast furnace on Mount Start, and 1 mile west-south-west of Duck Creek and the Chinaman freehold.

This is four men's ground—1,600 ft. × 350 ft. It was first held as a mineral selection. Early in this year it was reported to have been acquired with the Speculation and Horseshoe by the Celestial Copper and Option Co., Ltd.

Development.

The main shaft, which is 30 ft. deep, lies midway between the eastern and western boundaries and 1 ch. from the northern. An inaccessible underlie shaft, No. 2, lies 350 ft. to the west 14° south, is 30 ft. deep and has a crosscut running 7 ft. to the north at the bottom. Its dimensions at the surface are 10 ft. by 6 ft. and at the bottom 7 ft. × 5 ft.

Output.

1906 ... $4\frac{6}{20}$ tons shipped by Salveson (source doubtful).

Ore-bodies.

The ore-bodies occur on the continuation of the Chinaman-Speculation zone, here striking east 17° north, but there is a gap of

over half a mile between this lease and the freehold. Within 10 ft. east of the main shaft the formation is made up in great part of lenticular masses of quartz in schist producing a bold crop, 10 ft. wide and 1½ ch. wide. There being no siliceous crop to the west copper ore may be found in that direction. Besides the cupriferous areas at the shafts, there is a small rich patch of ore ½ ch. west of the main shaft and a poor patch 1½ ch. west, a third body of 15% ore cropping 1 ch. beyond the last.

No. 2 shaft was sunk on the southern side of a small blow. One small bunch of rich malachite-bearing tile-ore was cut in the eastern end of the shaft but most of the sinking was on a schist footwall in slightly cupriferous quartzite with numerous crystal-lined vugs, rather unusual in this district. The crosscut proved 18 in. quartz of no value.

In the upper part of the main shaft a width of 9 ft. of formation, dipping 5 in 1 h. to the south is exposed, between walls of schist. The footwall is well defined, is internally slickensided, and has every appearance of permanency. On the hanging-wall there is 9 in. to 18 in. of quartz, then 6 in. gossany material (*a*) and 2 ft. 6 in. malachite-stained schist, followed by 9 in. to 2 ft. of quartz, then 2 ft. of malachite-stained schist and 18 in. of quartz and gossan (*b*) on the footwall. At the bottom the shaft is contracted in size but, owing to the pinching out of the bands of schist and quartz, both of the gossany veins (*a* and *b*) are exposed. The former is 6 in. wide and consists of 6 in. earthy gossan, well worth sinking on; and the latter of 12 in. of copper-stained quartz.

The formation towards the surface could, without trouble, be picked to run 10% copper, crystallised azurite being fairly plentiful, but practically, the whole of the material raised from the shaft is cupriferous. About 30 tons of quartz, carrying perhaps 2% copper, have been thrown aside from the tip, which now contains about 120 tons. A surface sample of this ore consists of: black chloritic schist, stained by malachite along its laminations; quartz in lenticular form, with an external film of malachite; and cellular gossan and tile-ore, in which are distorted crystals of limonite, pseudomorphous after chalcopyrite, replacing schist. Assay results as follows (Government Analyst):

Copper	...	...	= 4·3 %
Gold	...	...	= 20 gr. per ton
Silver	...	...	= 1 dwt. 10 ,, ,,

A second line on which no work has been done crops about 12 ch. south of the Celestial. About midway between the two lines is a crop running west-south-west of amygdaloidal rock referred to above. (*See* under Commonwealth).

Speculation (M.C. 198).

Mgr., Leonard.

Location, Etc.

The Speculation adjoins the Celestial on the east.

The area is 1,200 ft. × 350 ft. This claim was reported in the Press (16-1-07) to have been taken over, with the Celestial and Horseshoe, by the Celestial Copper and Option Co., Ltd.

Development.

The workings comprise a shaft, 15 ft. deep, near the eastern boundary; a shaft 12 ft. long, 5 ft. wide and 10 ft. deep, 3 ch. from the western boundary; a cut ½ ch. west of the first shaft; and two other cuts 2 ch. and 2½ ch. west of the second shaft, 10 ft. and 6 ft. deep respectively.

Ore-bodies.

The excavations all expose schists and lenticular quartz veins, dipping steeply southwards, and some of them bands of gossan as well.

The eastern shaft gives a good idea of the nature of the crush-

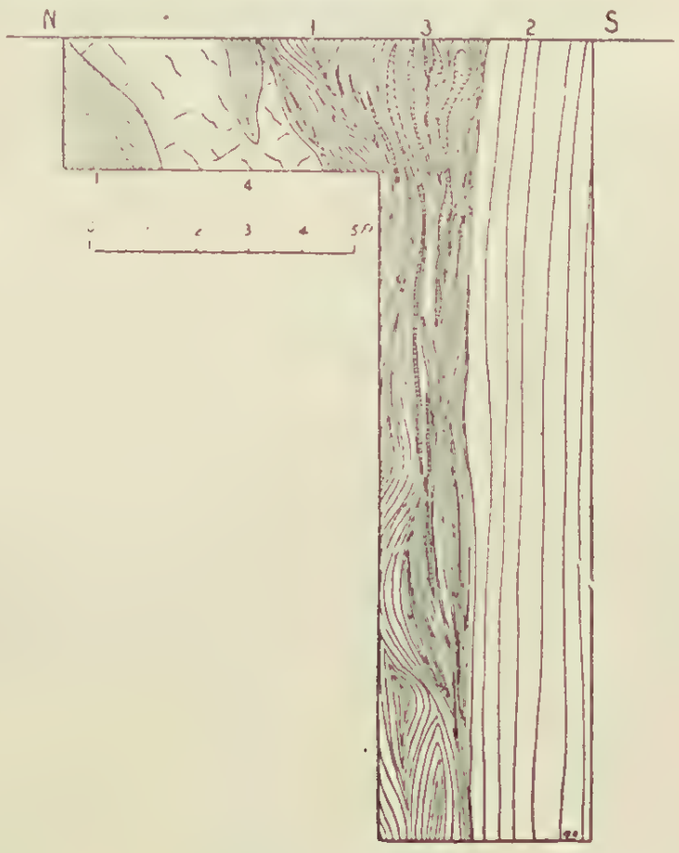


Fig. 17.—Section of formation, eastern shaft, Speculation claim.

1. Schist
2. Slate
3. Schist with quartz lenses
4. Quartz.

zones, in which lenticular bodies of quartz occur in schist. (Fig. 17.) Only 2 tons of cupriferous quartz and schist, carrying not more than 5% copper, have been paddocked.

In the adjoining trench to the west the exposure is rather better, there being two 6 in. bands of ferruginous schist and formation

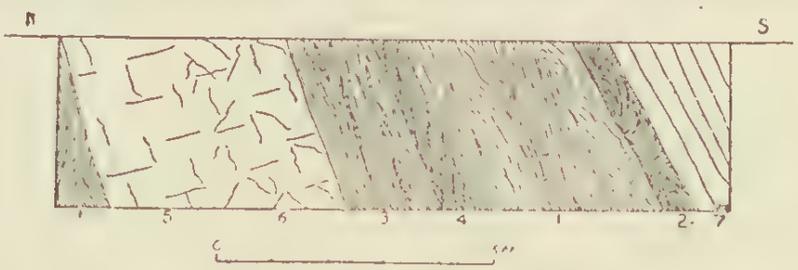


FIG. 18.—SECOND TRENCH, SPECULATION CLAIM.

1. Schist
2. Ferruginous schist
3. Cupriferous schist with quartz lenses
4. Reddish formation
5. Quartz
6. Broken quartz
7. Slate.

separated by 3 ft. of schist, between the quartz-bearing formation and the hanging wall slate. (Fig. 18.) The ore raised from here is very ferruginous as well as siliceous and the 6 tons paddocked should yield 15% copper.

The quartz of the crop, just to the west of these workings, exhibits horizontal corrugations resembling slickensides on a large scale, and apparently produced in the country rock during the crushing movement prior to or during the segregation of the quartz.

The only cupriferous crops between the two shafts are at 3 and 5 ch. distance from the eastern. At the former spot a few tons of malachite-bearing schist, carrying 10% copper, have been dug out.

The western shaft exposes a cupriferous formation 12 ft. wide, dipping (judging by the footwall schist) 3 in 1 h. to the south. The section is as follows, beginning at the hanging-wall altered slate: 2 ft. cupriferous schist and quartz; 2 ft. 6 in. cupriferous quartz; 6 in. cupriferous gossan; 18 in. poor quartz; 2 ft. 6 in. cupriferous quartz and schist; 18 in. cupriferous quartz. Rejecting the quartz the formation in the shaft appeared likely to bulk over 10% copper as carbonate. My sample from the whole length of the eastern face consists of crystalline and granular quartz and schist. The granular quartz contains flakes of schist and is stained by malachite, which also occurs in acicular form in cavities with hydrous iron oxides. The schist is also to some extent stained by malachite and hydrous iron oxides. The sample was assayed as follows (Government Analyst):

Copper	...	...	...	= 3·0 %.
Gold	..	...	...	= trace
Silver	...	...	...	= 2 dwt. per ton.

The first cut to the west of the last shaft exposes 6 ft. cupriferous formation between quartz lenses forming foot- and hanging-walls. It appears likely to average 10% copper. The 10 tons of ore paddocked comprise schist and quartz, with malachite and tile-ore, and are likely to yield 20% copper. This is worth further development.

The westernmost cut exposes 7 ft. width of cupriferous and ferruginous formation, likely to run 5% copper, chiefly as malachite, but there are some films of chrysocolla here also. The hanging-wall is slate, adjacent to it is 12 in. cupriferous schist, and then 12 in. barren schist, then 18 in. cupriferous schist; and adjacent to the footwall schist is 18 in. ferruginous and siliceous gossany schist, worth sinking, at least a shallow shaft on.

There is thus no defined lode here, but rather a crush-zone very siliceous and low in grade in the best parts, the copper being irregularly distributed.

A parallel crop, 7 ch. to the south of the above, has been tried in one place, where there is 2 ft. of quartz with gossan and a little copper ore. A little over 1 ton of 30% ore was shipped from here (by Salveson and Leonard).

Speculation West (M.L. 428).

Mgr., Weir.

Location, Etc.

The Speculation West adjoins the Speculation Claim (not the lease) on the west.

The area is $9\frac{3}{10}$ ac. Exempt when visited.

Ore-bodies.

The crop worked in the adjoining claim continues for over a chain into the lease, but no work has been done and no ore is exposed.

EVA GROUP.

The Eva, Jessie, Phœnix, Commonwealth and possibly the Captain are all on one or other of two lines, the Huia and Weka being somewhat to the south.

Eva (M.L. 250).

Mgr., Matheson.

Location, Etc.

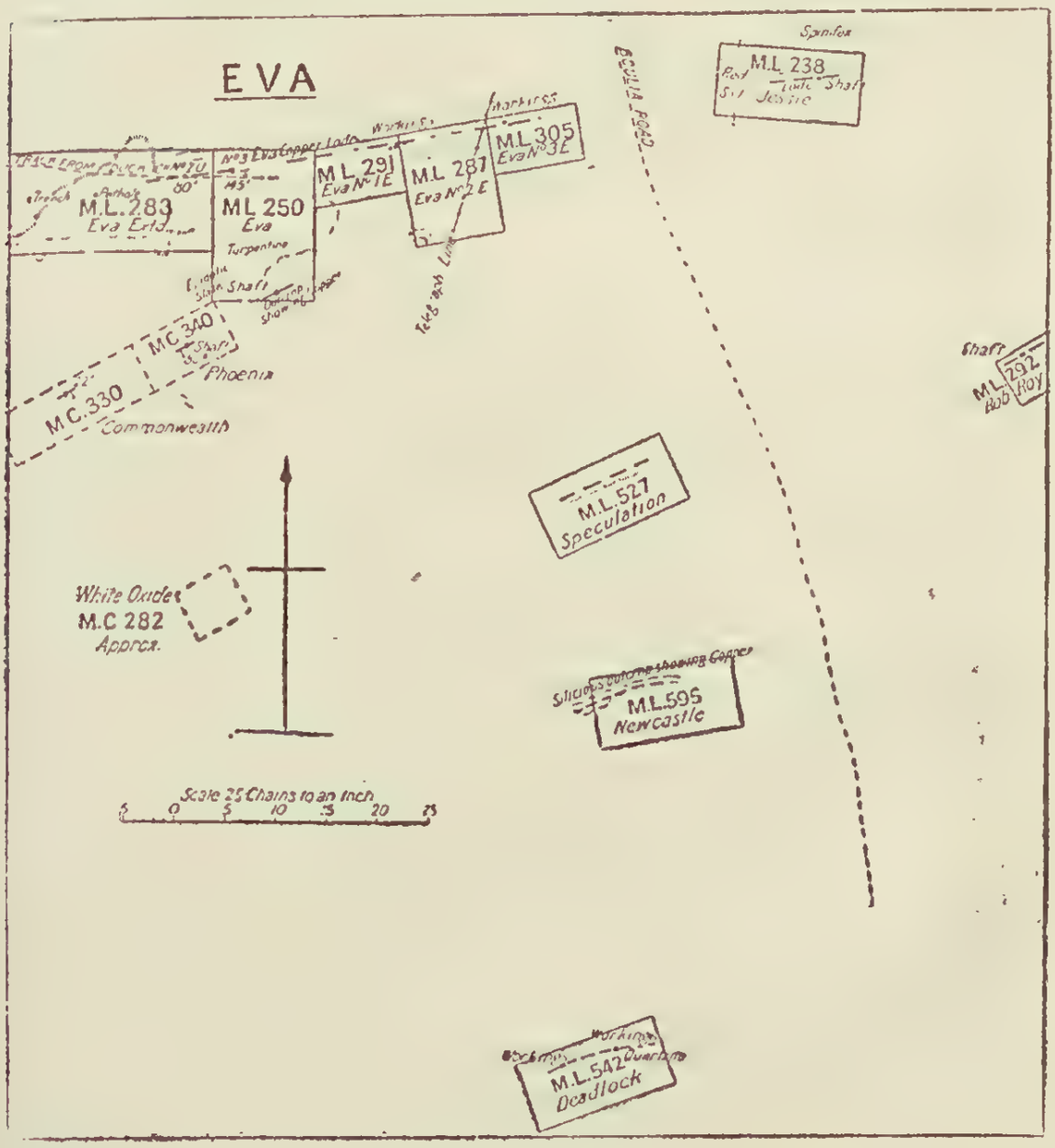
The Eva is a little over $\frac{1}{2}$ mile east of Duck Creek and $1\frac{1}{4}$ mile south-east of the blast furnace on Mount Start, which is $22\frac{1}{2}$ miles south-south-west of Cloncurry.

The area of the lease is 15 ac., and it is the property of the Willcocks Cloncurry Development Syndicate.

Development.

No. 3, the whip-shaft, 8 ft. × 3 ft. in the clear, is 300 ft. to the east 5° north. It is vertical to a depth of 120 ft. and below that underlies with the lode 7 in 1 h. for 25 ft. Water was standing in it 95 ft. below the surface and the ladders having been removed no inspection could be made. The absence of any quantity of free acid or mineral matter in solution is to be inferred from the fact that the water from this shaft was used for culinary purposes during the late drought.

The only other shaft is near the southern boundary of the lease, and now 12 ft. deep, underlying southwards. Since my visit this has been deepened to 50 ft., where drives have been opened 18 ft. east and 17 ft. west.



Ore-bodies.

The northern ore-bearing zone, on the line of which are the workings in the Extended and Nos. 1, 2, and 3 East, crops, in the

north-eastern corner of this lease, as iron-stained quartz with a little oxide-carbonate ore.

The whip-shaft has proved the lode, below 120 ft. depth, to underlie 70° to the south, the hanging-wall country being blue slate. Mr. Matheson informed me that the lode at the bottom is well defined and larger, but much poorer, than at the surface, there being 4 ft. width of quartz in places.* The ore, of which there are 70 tons paddocked, comprises schist and slate, interlaminated and replaced by quartz and pyrite, with a little tile-ore, azurite and chalcocite. That last raised shows cupreous pyrite in the gossany parts of a quartzose chloritic rock.

A rough sample taken from the surface of the paddock contains: greenish chloritic schist, both barren and cupriferous (malachite); barren crystalline quartz; loosely aggregated crystalline malachite; cellular gossan and limonite with disseminated chalcocite; chalcopyrite interstitial in the quartz; chalcopyrite minutely reticulated with chalcocite; and a little ferruginous granular calcite slightly stained by malachite. The assay return is as follows (Government Analyst):—

Copper	...	...	...	=	13·3 %
Gold	...	...	...	=	1 dwt. 4 gr. per ton
Silver	...	...	...	=	1 ,, 10 ,, ,,

The southern ore-body strikes east-north-east and dips steeply south-south-east. The crop is schist, with lenticular bodies of quartz only slightly stained with malachite and iron oxides. In the shaft the footwall schist is much slickensided internally, but no defined hanging-wall has yet been reached. The ore thus would appear to be in a crush-zone. Near the surface the ore-body was 2 ft. 6 in. wide, but in the sump it is 3 ft. across. The ore consists of an intergrowth of tile-ore and malachite, some of it very siliceous, crystalline quartz forming the greater part of the ore-body in places. About 20 tons have been paddocked and are expected to average 12% copper. The mullock amounts to only 3 tons.

The manager has reported since my visit that, at 20 ft. depth, there is 2 ft. 6 in. of 12% ore; at 28 ft. depth, 2 ft. 6 in. of 14%; at 34 ft., 12%; 38 ft. depth, 4 ft. of siliceous 12% ore; at 43 ft. depth, the full width of the shaft runs 12%; and at 50 ft. depth "a big body of siliceous ore" containing 12% copper. Further he reports that the drives were opened in 3 ft. of siliceous ore. In the eastern drive, at 12 ft. from the shaft, there is 2 ft. 6 in. very siliceous ore, but, at 18 ft., only 18 in. copper-bearing quartz. In the western drive, at 12 ft. from the shaft, the full face is fair quality ore and, at 17 ft., there is 4 ft. of siliceous ore (27th May, 1907).

* This has been reported to the Warden as unpayable.

Eva Extended (M.L. 283).

Mgr., Matheson.

Location, Etc.

This lease adjoins the Eva on the west.

The area is 20 ac. It is the property of the Willcocks Cloncurry Development Syndicate.

Development.

A cut has been opened a few chains from the western boundary; there is a pothole near the centre of the lease; and the main shaft, known as the No. 2, is in the north-eastern corner, 300 ft. from the No. 3 shaft in the Eva. No. 2 shaft, 7 ft. × 3 ft. in the clear was sunk on an underlie of 4 in 1 h. to the south to a depth of 80 ft., and drives were then opened 23 ft. east and west.

Ore-bodies.

The western cut was opened in quartz and limonite rubble and malachite-stained clay. The bottom cannot now be seen, but between 3 and 4 tons of siliceous ore, carrying tile-ore and malachite, have been stacked here. This ore carries at least 50% silica and only 10% copper.

In No. 2 shaft the average size of the ore-body is 12 in. to a depth of 20 ft., where it pinches to 2 in., gradually increasing again to 18 in. In the end of the eastern drive there is 9 in. gossan and, in the end of the western, 3 in. gossan with some lenses of calcite, both faces being poor in copper but promising in appearance. There is 8 in. width of good ore nearer the shaft on each side. The hanging-wall country is slaty or blocky schist, while the footwall is formed of typical chloritic schist, much slickensided near the ore owing to crushing. Flakes and lenses of the rock are found all through the ore-body, showing that the metallic minerals have been deposited not in an open fissure but rather in a crush-zone.

There are 10 tons of ore at grass from this shaft—comprising schist altered and replaced and containing gossan, malachite and tile-ore—expected to run over 30%. My sample consists of: dark-green chloritic schist, gossany in part and also replaced by tile-ore, malachite and glance stained by malachite; cellular gossan with impregnations of malachite; glance stained by malachite and containing original chalcopyrite; much granular quartzite with chlorite of the original schist; some barren quartz; and a little calcite. The Government Analyst has assayed it for:

Copper	...	...	...	=	20·8 %
Gold	...	...	...	=	1 dwt. 14 gr. per ton
Silver	...	...	...	=	5 ,, ,,

Eva Nos. 1, 2 and 3 East (M.L. 291, etc.).

Mgrs., Hulbert, Entricken and Byrne.

Location, Etc.

These leases have been taken up in order adjoining and to the east-north-east of the Eva.

The No. 1 East (M.L. 291) has an area of 5 ac.; No. 2 East (M.L. 287) has an area of 10 ac.; and No. 3 East (M.L. 305) has an area of 5 ac.

Development.

The workings on the No. 1 and No. 2 East are on the dividing line and those on the No. 3 East are in the western part. They comprise old shafts and open-cuts, which have been long idle and have collapsed.

Ore-bodies.

The ore bodies worked appear to be on the continuation of the main Eva crush-zone.

Output.

1904	...	11	tons shipped by	Brady,	carrying	32½	%	copper
		6	,, ,,	Woodgate,	,,	35	%	,,
1905	...	8	,, ,,	Brady				
		3 19/20	,, ,,	Woodgate				
1906	...	3	,, ,,	Wilmot				
		31 19/20						

Jessie (M.L. 238).

Mgr., Matheson.

Location, Etc.

The Jessie lies ¾ mile east-north-east of the Eva, just beyond the Boulia road. The surface here is a flat rolling peneplain, the soil being red and gravelly.

The area is 10 ac. The lease is the property of the Willcocks Cloncurry Development Syndicate.

Development.

One shallow hole had been opened, in October last, in the centre of the eastern half of the lease, and besides it there were unsuccessful trenches 1½ ch. and 3 ch. to the east.

The managers' reports, since my visit, state that a shaft was begun in November last, and at the end of the year was 44 ft. deep. It has been continued to 50 ft. and a drive, opened eastwards, was 30 ft. long at the end of March. Sinking was then resumed.

Output.

1904 ... 24 19/20 tons shipped.

Ore-bodies.

The crop, which strikes east and west, dipping 80° to the south, can be followed for ½ ch. west of the hole (with traces for 2½ ch.

beyond) and for 10 ft. to the east in schist country. It is formed of limonite and quartz in which malachite stains appear immediately under the surface. There has been a slight deposition of secondary chalcedonic mammilated silica on some of the ore, since its oxidation to limonite, which has also in a few places been rendered cherty.

In the hole is exposed 3 to 6 ft. of quartz, cemented by limonite, some of it gossany and stained by malachite. This ore contains over 50% silica and probably less than 10% copper in the richest parts.

In the shaft sunk since my visit, the manager reports that the ore-body at 12 ft. depth is 3 ft wide and assays 21% copper; and, in sinking 12 ft., 20 tons of 21% ore were raised. At 24 ft. depth it is 2 ft. wide and 10 tons of 33% ore were raised in sinking 12 ft. Between 24 and 36 ft. the sinking was in siliceous ironstone (said to be hæmatite in one report) of no value, but at 44 ft. depth it showed an improvement, and was 4 ft. wide (29-12-'06). To 50 ft. it continued 4 ft. wide but was still low in copper. Rich ore, 25 to 30% copper, was struck in the eastern drive at the 50 ft. level 4 ft. wide, at 24 ft. from the shaft—15 tons of 25% ore were broken down in driving from 14 to 24 ft. and 10 tons of 30% ore in driving from 24 ft. to 30 ft.

At 54 ft. in the shaft there is 2 ft. 6 in. width of ferruginous quartz; and at 58 ft. there is 18 in. siliceous gossan (27-5-'07).

Phœnix (M.C. 340).

Mgr., Walsh.

Location, Etc.

The Phœnix adjoins the Eva on the south-west.

This is three men's ground—600 ft. by 350 ft. It was deserted when visited.

Only one shallow shaft has been opened here.

Ore-body.

The ore-body here exposed is on the line of that being proved in the southern shaft on the Eva lease, the strike being east 30° north. In the shaft 3 to 5 ft. width of cupriferous formation can be seen, dipping 80° to the south-south-east. The formation is chloritic schist, with much quartz and impregnated with malachite, tile-ore, and a little chalcocite. About 4 tons of firsts running 10 or 15% copper have been paddocked, the seconds, carrying 5% copper, amounting to 3 tons.

The work done here is of no importance except that it proves the southern crush-zone on the Eva to continue for at least 10 ch. to the west-south-west.

Commonwealth (M.C. 330).

Mgr., Artz.

Location, Etc.

The Commonwealth claim adjoins the Phœnix on the south-west. This is five men's ground, 1,000 ft. × 350 ft.

Development.

Work had only just commenced here in October last, the first shaft near the centre of the claim being 22 ft. deep, and a start having been made on a second, 1½ ch. to the east-north-east, when visited.

Output.

1906 ... 4 tons shipped.

Ore-body.

The ore-body exposed in the shaft is rather to the north of the line of strike of those in the Phœnix and the southern part of the Eva. Its strike is east 35° north, which would carry it much to the north of the workings on the above line; but its dip is 3 in 1 h. to the south-eastwards.

The ore here is tile-ore, chalcocite (glance) and malachite, with just a trace of chrysocolla. It occurs in the crushed hanging-wall country for 2 ft. from a quartz vein 2 ft. 6 in. thick. No considerable body of ore has yet been found, but there is a possibility of the amount increasing as the quartz pinches out. Only 1 ton of firsts (20% ore) had been bagged, the seconds (10% ore) produced being 3 tons.

A little chalcopyrite-chalcocite-limonite has been found in the eastern hole.

The footwall country is a hard silicified schistose rock, much crushed towards the shaft bottom and there showing internal slickensides. In this neighbourhood are found besides schists highly altered rocks, in which segregation of quartz and calcite has taken place, giving them some resemblance to amygdaloidal volcanics.

Captain (M.L. ?).

Mgr., Bushnell.

Location, Etc.

The Captain lies on the western bank of Duck Creek, 2 miles south of the blast furnace on Mount Start.

A 10-ac. lease was to be applied for, but in October, 1906, the papers had not been sent in. The ground was formerly held as the Watercourse by Madden.

Development.

The holders of the Watercourse opened one trench in 1904. The new shaft, which was only 10 ft. deep when seen, is located below the bank of the creek and likely to be flooded during freshes.

Output.

1906 ... 3 tons shipped.

Ore-body.

The strike of the ore-body is east 33° north, the ore replacing schist in a crush-zone—quite possibly a continuation of the southern Eva-Phœnix-Commonwealth. The country rock is a blocky slate the joints of which are coated with a white calcareous powder. It forms a smooth hanging-wall dipping 3 in 1 h. south-eastwards. East of the workings the country is a hard dark chloritic slaty rock, with thin siliceous bands almost free from chlorite but containing occasional granules of chalcopyrite. It is locally known as diorite.

The formation at the north-eastern end of the shaft is 5 ft. wide, there being 6 in. of quartz, with strong stains of malachite and azurite and bunches of tile-ore, on the hanging-wall; then 6 in. high-grade, sometimes nearly pure, chalcocite (glance) ore with quartz; then 9 in. cupriferous (radiating malachite) gossan; then 4 in. chalcocite and quartz; then 12 in. chloritic schist and then siliceous cupriferous (chrysocolla) gossan and gossany quartzite to the foot-wall. In the south-western end a horse of schist splits the ore-body into two legs 2 ft. wide and 4 ft. apart.

There was about 6 tons of unpicked ore at grass, and it may be expected to carry at least 20% copper; the bagged ore—chalcocite, tile-ore and malachite with a little quartz—amounts to 1½ tons and should yield 40% copper.

Huia (Extended M.C. 270).

Mgr., Michail.

Location, Etc.

About ½ mile south-east of the Captain.

The area is 800 ft. × 350 ft. Since abandoned.

One opencut has been excavated here but has now fallen in.

Weka (M.C. ?).

Mgr., Higgie.

Location, Etc.

The Weka lies about ¾ mile south-east of the Captain and ¾ mile north-west of the Deadlock.

The area is 200 ft. × 350 ft. The ground had not yet been applied for when visited.

Work had just commenced here, only one trench having been opened.

OUTPUT.

1906 ... $\frac{15}{20}$ ton shipped by Higgie.

ORE-BODIES.

The ore-body being opened up is 9 to 12 in. wide and carries malachite, chrysocolla, dioptase (?) and a little atacamite, about 1 ton of such ore being paddocked. The country rock near the ore-body is a blocky schist, almost free from quartz veins. Some radiating black tourmaline was found in the altered sedimentaries $\frac{1}{2}$ ch. south of the cut.

About 15 ch. south-east of the Weka workings there is a cut along a crush-zone running north 30° west, in very ferruginous and rather siliceous copper-bearing material.

WHITE OXIDE GROUP.

The White Oxide appears to be on the continuation of the Speculation and Rob Roy crush-zone, the Newcastle being on a parallel zone to the south.

White Oxide (M.C. 282).

Mgr., Ford.

LOCATION, ETC.

The claim is $\frac{1}{2}$ mile west-north-west of the Newcastle.

It embraces two men's ground—400 ft. × 350 ft.

The shaft, in process of sinking, is now 20 ft. deep (October, 1906).

ORE-BODY.

The strike of the ore-body is east-south-east, the dip being 1 in 1 to the south-south-west, and it is therefore believed to be on the Rob Roy crush-zone. The cupriferous crop, in which the shaft is sunk, can be traced to a large blow of quartz $1\frac{1}{2}$ ch. to the west.

A formation 2 ft. 6 in. wide, with well-defined hanging-wall, to be seen in the shaft, consists of altered slate, tile-ore, malachite and a little quartz. The firsts bagged amount to $4\frac{1}{2}$ tons and are expected to yield 30% copper, while the $2\frac{1}{2}$ tons seconds should yield 10%.

The dark crystalline rocks, in the vicinity of the shaft, have the appearance of certain intermediate eruptives, but, until a microscopic examination has been made, the country is to be considered of sedimentary origin, though highly metamorphosed.

Speculation (M.L. 527).

Mgr., Miller.

LOCATION, ETC.

The Speculation lies about ½ mile west-south-west of the Rob Roy and the same distance south-east of the Eva.

The area is 10 ac. It was not inspected by me.

ORE-BODY.

The Speculation is on the Rob Roy zone.

Rob Roy (M.L. 292).

Mgr., Sleight.

LOCATION, ETC.

This lease is a little over ¼ mile south-east of the Jessie.

Its area is 5 ac.

Only one shallow shaft has been sunk.

OUTPUT.

1904 ... 22 tons ore shipped, carrying 30 % copper (source doubtful).

ORE-BODY.

A quartz and schist zone strikes east 30° north as on the Eva (south).

Newcastle (M.L. 595).

Mgr., Harvey.

LOCATION, ETC.

The Newcastle lies about 2 miles south-east-by-south of the blast furnace on Mount Start and 10 ch. west of the Boulia road.

The area is 10 ac.

Only one or two potholes have been opened here.

ORE-BODY.

The crop is schist and quartz, with patches carrying malachite, presumably on a shear-zone striking east-south-east, and the same as that being tested on the White Oxide. Very little ore is visible here.

ALICE GROUP.

The Alice, Deadlock, Iron Duke and Mount Surprise are included in one group for convenience in describing, though they have no apparent connection.

Alice (M.L. 717).

Mgr., F. H. Green.

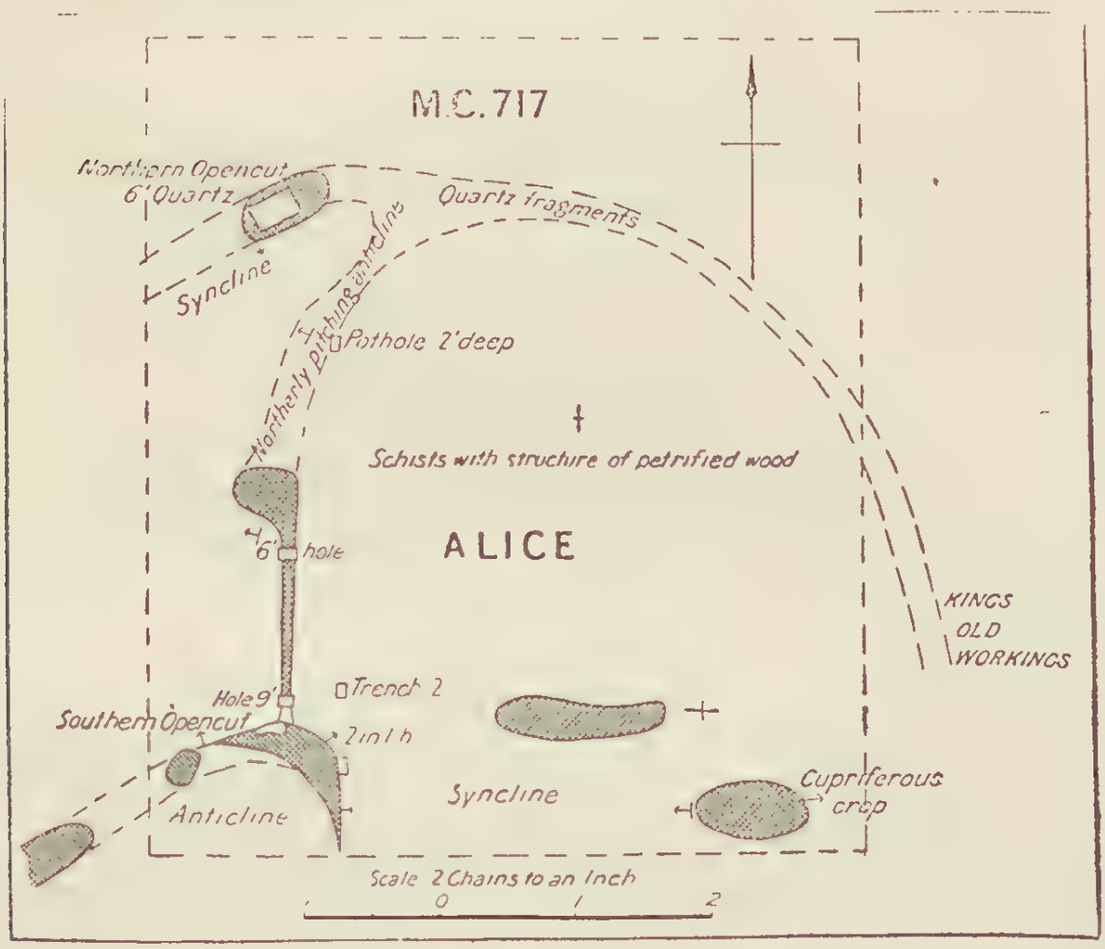
Location, Etc.

The Alice lies 1 mile south 40° east from the Rob Roy, and 1 mile east of the Boulia road, 1½ miles north-east of the Duck Creek crossing.

The area is 20 ac. When visited the ground was held as an extended claim (M.C. 73)—one man's ground. It was first taken up 30 years ago as a mineral selection.

Development.

The workings comprise: two opencuts, one in the south-western corner being 10 ft. long, 5 ft. wide and in parts 8 ft. deep, the other, in the north-western corner, being 15 ft. by 10 ft. and 4 ft. deep; a



trench (No. 2), 25 ft. north-east of the southern opencut; and four potholes; No. 1, about 20 ft. east of the southern opencut; No. 2, 9 ft. deep a few feet to the north of the cut; No. 3, 6 ft. deep × 10 ft. long 1 ch. to the north, and No. 4, 2 ft. deep, 1½ ch. beyond.

Output.

1904	...	23	tons shipped by Green (source doubtful).
1905	...	7	,, ,, ,,
1906	...	$7\frac{12}{20}$	,, ,, ,,
Total		$37\frac{12}{20}$*	

The Wardens have also recorded the following shipments from the adjacent Rainbow claim:

1904 ... 6 tons shipped by Laws and King
1906 ... 6 ,, ,, King and Davis.

Ore-bodies.

The greater part of the Alice is underlain by a flatly undulating body of quartz, only the uppermost parts of the anticlines reaching the surface. The underlying rock is a soft grey decomposed slate, the overlying rock, to which the quartz is often "frozen," being kaolinised schist with a coarsely fibrous structure, as in some specimens of petrified wood.

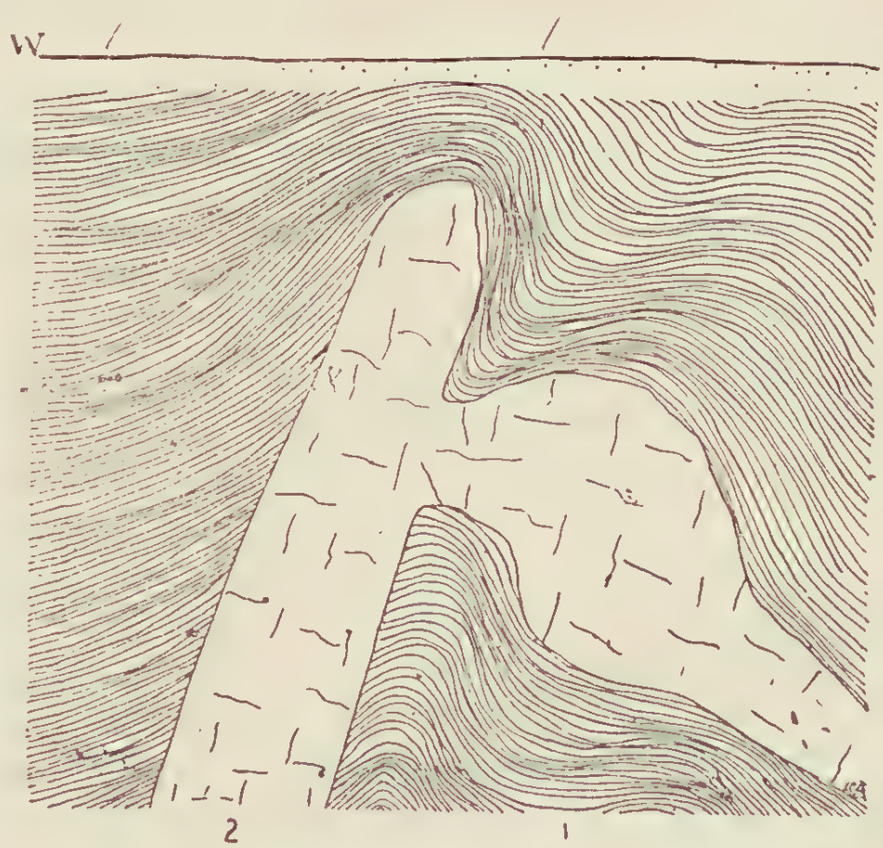


Fig. 19.—section in end of no. 2 trench, Alice.

Scale: 1 ft. to an inch.

1. Schist | *2. Quartz.*

In the southern opencut the quartz body is almost horizontal, dipping flatly ($\frac{1}{2}$ in 1 h.) east, north and north-west, wherefore the

* Mr. Green informed me he had shipped 25 tons of ore, yielding 35 to 49·7% copper, and that 5 tons of 40% ore had been shipped by Brady.

body appears much larger than is actually the case. Bunches of gossan, tile-ore, malachite and chrysocolla—the last two filling in a siliceous skeleton, and the malachite also in radiating masses, up to 3 in. in diameter, encrusted by a thin film of secondary silica or by chrysocolla—are scattered irregularly, through the quartz, more especially about 2 ft. under the hanging-wall. The whole width would average less than 2% copper, but it should be possible to work the malachite-bearing bands apart from the quartz, which was first worked for gold, specks of the metal being often seen in breaking up the stone. There are 2 tons of firsts, containing 40% copper, ready for shipment, besides 1 ton of seconds, containing 30%; and 3 tons of very siliceous thirds, containing 10% copper.

Trench No. 2 exposes a 12 in. quartz vein, which cuts across the strata and yet does not reach the surface, being evidently a spur from the main body. (Fig. 19.)

A 4 ft. vein and spur, with ill-defined walls dipping 3 in 1 h. to the west, are exposed in No. 3 hole. One quarter of this is cellular gossan, with a fair staining of malachite and chrysocolla, and the remainder is quartz. This is one of the best faces seen in the district, and some very good ore is said to have been raised.

The northern opencut shows 6 ft. quartz and cellular gossan. The hanging-wall country is very micaceous and gossany, with malachite near the surface. Some good ore has been also obtained on the footwall. This crop is well worth sinking on, because of the cellular gossan, which is likely to give place to copper-bearing pyrite in depth. About 1½ ton of 36% ore has been shipped from here.

Deadlock (M.L. 542).

Mgr., Allis.

Location, Etc.

The Deadlock lies about 1¼ mile south-east of the Eva, and ¼ mile west of the Boulia road.

The area is 10 ac. It was deserted when visited in October last.

Development.

The main shaft is 30 ft. deep and inaccessible; the only other workings are potholes, 30 ft. east and 30 ft. west of the shaft.

Output.

Total ... 30 tons shipped—30 % copper.

Ore-bodies.

Quartz and quartzite, with occasional bunches of ore, form a blow, a chain long and 8 ft. wide, just to the east of the workings.

Quartz crystals, up to 3 in. across, with some secondary jasper, line a central cavity in the blow. Malachite-bearing gossan appears at the eastern end of this crop, but has not yet been broken into.

The potholes expose formation similar to, but poorer than, that in the shaft, where it is 3 ft. wide and dips 5 in 1 h. to the south, the strike being east and west. The formation comprises schist and quartz, with malachite and tile-ore, and this material practically forms the whole of the dump. It should not be a difficult matter to raise the copper content in this to 15% by picking out barren quartz. The seconds at grass amount to 10 tons and should yield 20% copper.

Mount Surprise (M.L. 301).

Mgr., King.

LOCATION, ETC.

Mount Surprise lies ¾ mile south-south-east of the Alice, 1 mile east of the Boulia road and 3¾ miles south-east of the blast furnace on Mount Start.

The area is 10 ac. Deserted in October.

No work has yet been done here. The zone could easily be proved by adits, but does not appear to be worth it.

ORE-BODIES.

There is here a north-east and south-west striking crush-zone, somewhat similar to the Tharsis, vertical lenses of quartz and occasional patches of malachite-bearing rock occurring in schist over a width of 30 ft. The strike is north-east and south-west. The siliceous nature of the crop has enabled it to more successfully resist denudation than the surrounding country, and it consequently now rises some 50 ft. above the general level of the plain.

Iron Duke (M.L. ?).

Mgr., Orchard.

LOCATION, ETC.

The Iron Duke is about ½ mile west of Mount Surprise.

The area is (?) ac. The ground had only just been pegged out when visited, and the lease application had not yet been granted.

Two potholes have been opened, 30 ft. apart.

OUTPUT.

Total ... 3 tons shipped by Brady (*fide* Mr. Ford).

ORE-BODIES.

The north-eastern hole exposes a gossany formation 6 in. to 2 ft. wide, dipping 70° to the south-west.

The south-western hole is at the intersection of spurs from the north-east and west with a north-west striking vein of quartz.

There is also a formation, 3 ft. wide, in which are lumps of calcite and copper ore, together with much cellular gossan. This is worth sinking on. The ½ ton of firsts at grass should yield 30% copper. The ½ ton of seconds contains a chalcopyrite mosaic in limonite cementing fragments of crystalline quartz, the oxidised copper having crystallised in cavities as malachite.

A third crop, 1 ch. to the south-west, shows 5 to 6 ft. of quartz with some gossan, but it has not yet been broken into. Its general strike is north-west and south-east, but there are several slight bends.

There is, ½ ch. to the south-west of the last, a fourth parallel crop, on which no work has been done.

TAMBOURINE GROUP.

The Tambourine Group lies midway between the Duck Creek and Corella Groups, and, being on Duck Creek waters, is included with the former. The ore-bodies seen are unimportant in size, and, occurring on bedding planes, are not promising, but their association with the boro-silicate tourmaline is to be noted as being indicative of a deep-seated origin.

Tambourine (R.C. 286).

Mgr., Brockett.

Location, Etc.

The Tambourine is located on one of the head branches of Duck Creek, 26 miles south-west of Cloncurry and 3 miles north of the Duck Creek-Corella road. It is in low open rolling country just to the south of a precipitous range.

Its area is 80 ac.

Development.

One shaft has been sunk near the centre of the claim to a depth of 20 ft., but, being in the creek bed, was full of water when visited. Only one other pothole, a few feet deep, has been opened on the outcrop.

Output.

1906 ... 8 tons shipped.

Ore-bodies.

Several lines of crop have been found on the claim, but only that proved by the shaft is of any economic importance. This comprises isolated bunches of ore in marl-bearing schists and highly altered slates, the ore consisting, as proved in the pothole, of schist and black quartz stained more or less by malachite. The general strike is north 36° east, which appears to be that of the country rock.

The shaft is on an 18 in. crop of gossan, and chalcopyrite, chalcocite and pyrite were met towards the bottom. The firsts shipped

included 25 bags of malachite in fine radiating nodular masses, free of visible impurity except silica, which has been deposited as thin coats round the nodules. The 3 tons of seconds at grass probably carry 10% copper, and consist in great part of cellular siliceous gossan in which can be distinguished casts of the original pyrite. Secondary silica is present in some quantity with chrysocolla, and both malachite and azurite are to be seen. The gossan cannot be followed for many yards and most of the copper is therefore probably limited to the one shoot, quartz with little copper occurring on the line to the south-west. The association of tourmaline (schorl) with this quartz is interesting as it is indicative of pneumatolysis having played some part in the genesis of the ore-body. (Cf. the Weka at Duck Creek, etc.) Near the centre of the southern line of the lease there are numerous patches of quartz stained by malachite and containing limonite and tourmaline, the country here being a jointed micaceous slate. Between the main line and these outcrops many bunches of quartz have been located on the bedding planes of the country rock.

Tambourine South (M.L. 536).

Mgr., Brockett.

LOCATION, ETC.

This adjoins the Tambourine claim on the south-west.

Its area is 10 ac.

No work has been done on this lease, and it is likely to be surrendered, as no indications of ore-bodies have been found on it.

Banjo (M.L. 590).

Mgr., Smith.

LOCATION, ETC.

The Banjo is located on the northern side of a ravine, in the range $\frac{1}{2}$ mile north of the Tambourine.

Its area is 5 ac.

DEVELOPMENT.

Two shafts have been opened in the north-western part of the lease. The lower shaft is 20 ft. deep, and the upper, which is 25 ft. to the east, is 10 ft. deep.

OUTPUT.

1906 ... 16 tons ore shipped.

ORE-BODIES.

Two parallel ore-bodies, 20 ft. apart, have been exposed here, with a north-east strike and a steep dip to the south-east. The country rock is schist and slate, the general strike of which in the

range to the north is north-east and south-west, the apparent dip of the schists being to the north-west, while that of the slates is to the south-east. This is presumably due to induced cleavage, but may be accounted for in some degree by folding.

At the lower shaft slates exhibit a north-and-south cleavage, and the ore-bodies consequently give a false impression of being on a true fissure, although the walls are not well defined. Near the surface only 6 in. of quartz and ferruginous kaolinised slate can now be seen, but chrysocolla was found in some quantity in the upper part of the shaft in one specimen obtained, replacing fibrous malachite and retaining its structure; and pyrite and chalcocite-veined chalcopyrite are showing in the bottom, where the lode is nearly a foot wide. The richly cupriferous shoot is evidently not more than 5 ft. in length. The firsts bagged from this shaft amounted to 10 tons, and the seconds to 2 tons. The former included malachite, chrysocolla, and glance-impregnated chalcopyrite, and the latter carried 5% copper chiefly as chrysocolla.

The upper shaft exposes a vein of copper ore, $\frac{1}{2}$ in. to 3 in. wide, between jointed chloritic schist on the north-west and ferruginous quartzite on the south-east, the latter probably an original bed. On the northern side of the shaft the vein pinches to 1 in. (chiefly chrysocolla), but there is said to be 3 in. width of ore below the mullock in the shaft bottom. The firsts, of which 6 tons have been shipped, carry very finely divided native copper in tile-ore. About 1 ton of seconds—siliceous limonite with chrysocolla malachite and dioptase (?)—are at grass and are believed to carry over 10% copper.

SLATY CREEK.

The ore-bodies seen within the catchment area of Slaty Creek above the Gorge Hotel are, with one or two exceptions, characterised by an east and west strike. The country is highly metamorphosed and the quartz, limestone and copper ore-bodies are typically lenticular in form, being especially well developed on the flat country west of the Two-Mile well, which is itself sunk in highly altered slate veined with quartz and calcite. The limestones may be organically derived and therefore original strata, or may, like the quartz, have segregated during the progress of the metamorphism. The copper ores may also in part have been concentrated from originally cupriferous country, but the pneumatolytic mineral, tourmaline, found on McEvoy's claim with bismutite, points to another source—*i.e.*, a deep-seated igneous magma. As bearing on the general geology of the Slaty Creek, a note should be made of the crystallisation of quartz in ferro-calcite, almost as in graphic granite, about ½ mile south of the Brilliant, somewhat similar to the occurrence at Mount Wheeler. Some trenching has been done here, revealing the presence of a little copper ore.

At the smelter site, to the east of the Gorge Hotel, schists and highly altered saccharoidal limestones are to be seen striking north and south. The schists have lenticular veins of quartz developed in them, and the same mineral occurs crystallised with ferro-calcite and ilmenite.

The ranges, which have a general north and south alignment, are, in great part, built of quartzite and gossan. On the western side of the range, about 1 mile south of the Hotel, much manganese dioxide is developed in slate, striking north-north-west, but exhibiting a well marked slaty cleavage running north-north-east and dipping east-south-east. Again, about ½ mile south-west of the Hotel, is to be seen a well marked west-north-west crop of black siliceous rock, containing scattered crystals of pyrite and magnetite.

As mentioned under topography, this is one of the best localities in which to note the progress of the reduction of the old Cloncurry peneplain. Not only can the former coextension of the mesas and flat topped ridges be imagined, but the general elevation of the conical hills and hogbacks is noticeably similar. The conical hills further form groups, and are plainly due to the dissection of mesas or ridges.

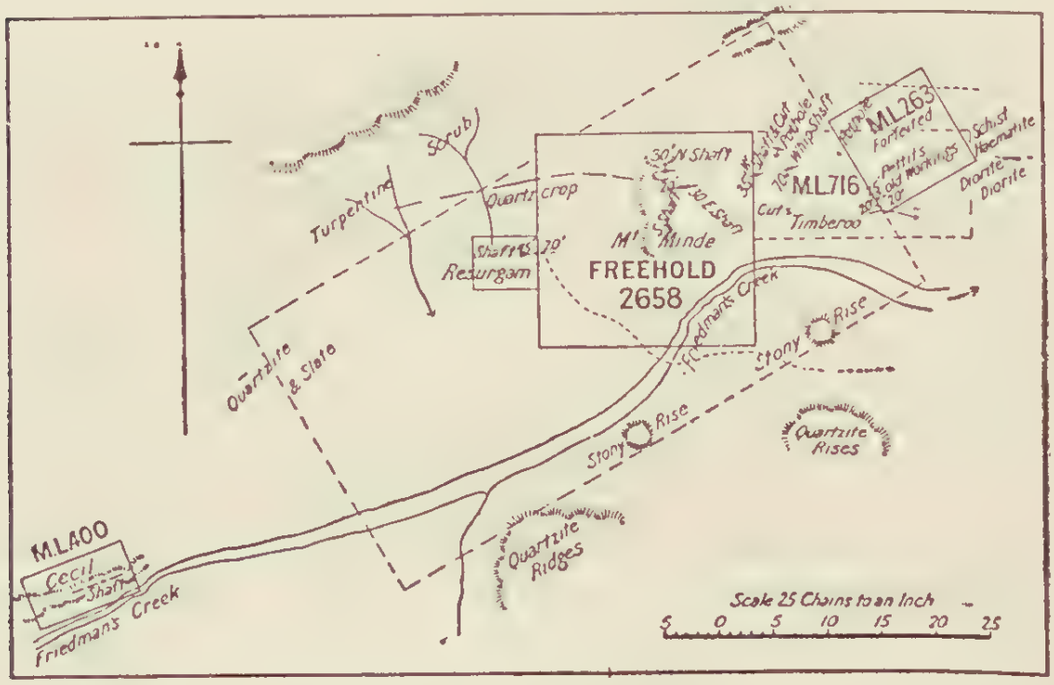
A number of claims on Slaty Creek could not be seen owing to general ignorance as to their exact location.

Output.

The total output for the years 1903, 1904, 1905, and 1906 is 323 tons of ore of an average tenor of 30% copper.

TIMBEROO GROUP.

The Timberoo group includes holdings in the vicinity of the old Mount Minde Freehold, lying between Slaty Creek and Mount Sheaffe.



Mount Minde (M.F. 2658).

Location, Area, Etc.

This freehold is situated on Friedman's Creek, a branch of Slaty Creek, 18 miles south-west of Cloncurry. It is 3 miles by road from the Gorge Hotel.

Its area is 40 ac. Deserted at time of visit.

Literature.

(2) Dr. Jack speaks of the Mount Minde in the following terms:—

The northmost of the copper lodes *(Selection No. IX.)* is situated on the west side of the road, about 20 miles from the township, and within the drainage area of Slaty Creek, a large tributary of the Cloncurry. It is about one mile to the north of Mount Sheaffe, whose position is given on the map. The slate of the country in which the lode occurs strikes WSW. to ENE. Near the lode is a mass of diorite. Its relation to the slate is not very clear, but it is, in all probability, intrusive, and may be suspected to have influenced the production of the copper ore. The principal lode strikes WNW. to ESE. For about twenty yards it stands seven or eight feet above the ground. It has a quartz matrix, with great pockets of green carbonate of copper, red oxide, and "tile ore." A branch lode strikes off it to the south-east. It contains some green carbonate, which I should estimate to contain 40 per cent. of metallic copper, and some red oxide mixed with silica, which I should reckon 30 per cent. ore. From what can be seen at the surface, I should say this mine is capable of turning out a large quantity of payable ore.

(8) Mr. Gibb has published the following analysis (Government Analyst):—

(r) Rejected from ore raised—

Copper	=	18·9
Silica	=	10·3
Iron protoxide	=	45·7
Alumina	=	5·3
Lime	=	tr.
Sulphur	=	0·4
		80·6

Development.

The workings include one trench and four shafts, which, it is understood, were put down during 1904 by a tributer (Purvis). The northern shaft, within 4 ch. of the northern boundary of the freehold, was begun 10 ft. north of a crop, and is vertical for 20 ft., and then underlies northwards for 10 ft. The southern shaft, 2½ ch. to the south-east, is 20 ft. deep, and 10 ft. east of it is the eastern shaft, which is 30 ft. deep, and connected with the former by a drive at 10 ft. depth. The western shaft, 20 ft. deep, is near the western boundary. All these workings, having been so long abandoned, are inaccessible.

Output.

		Aver. 38 %
1904	...	24 tons (Purvis), shipped, averaging 38 % copper.
1905	...	79 ,, (Allis).
Total	...	103

Ore-bodies.

Two separate ore-bodies have here been worked, the northern striking east-north-east (and dipping northwards), and the southern east-by-north (and vertical). Contorted but generally vertical lenticularly quartz-veined schists crop on the hillocks to the west, and chloritic schist has been thrown out of the southern workings.

The cap of the northern ore-body, where exposed over a length of 10 ft. in the trench, is barren quartz and dense limonite, up to 4 ft. in thickness, but pinching to 1 ft. at the western end. The country here is epidotic slate, in which are veins of muscovite rock. Nothing can be seen in the shaft, but about ½ ton of ore—limonite with a little cuprite and malachite and some chalcopyrite, probably running 15% copper—has been left in the paddock. A greenish-white hydromica occurs in aggregates, with occasional quartz crystals in the oxidised ore here.

In the southern shaft, a body of cupriferous gossan, 18 in. wide, is cut out, at 10 ft. below the surface, by a head, dipping 45° to the south. The country is stained by malachite, and should carry 2 to 3% copper over a width of 4 ft. beneath the head, which ought therefore to be followed down. The drive is in rich but siliceous oxide and carbonate.

The eastern shaft also exposes 18 in. of ore (10% copper) between fairly well defined walls. Further development should therefore be undertaken here.

The western shaft is on the line of strike of the Resurgam orebody, but only stains of copper have been found in it.

A large vein of quartz crops in the north-western part of the freehold, and if continued would run into the Timberoo workings, but within 10 ch. of them it ends quite abruptly as towards the west. It stands out like a wall, 5 to 20 ft. wide, for at least 5 ch. to the west 10° south of the freehold, and some fairly rich boulders of copper ore there lie scattered over the surface. For the most part, however, the crop is barren, in only one or two places being strongly ferruginous and slightly cupriferous.

Timberoo (M.L. 716).

Mgr., Matheson.

LOCATION, AREA, ETC.

The Timberoo adjoins the Mount Minde freehold on the north-east.

Its area is 20 ac. This lease has been taken up by the Willcocks Cloncurry Development Syndicate, to include the workings on surrendered leases Nos. 200 (surrounding the freehold) and 263 (lying to the north-east) previously worked by Allis and party.

LITERATURE.

(8) Mr. Gibbs gives the following analyses (Government Analyst):—

Left in reef—		Selected for shipment—	
Copper	= 25·8	Copper	= 47·6
Silica	= 13·9	Silica	= 5·9
Iron protoxide	= 30·3	Iron protoxide ...	= 16·2
Alumina ...	= 6·5	Alumina	= 2·1
Lime	= tr.	Lime	= tr.
Sulphur	= 2·9	Sulphur	= 9·2
	79·4		81·0

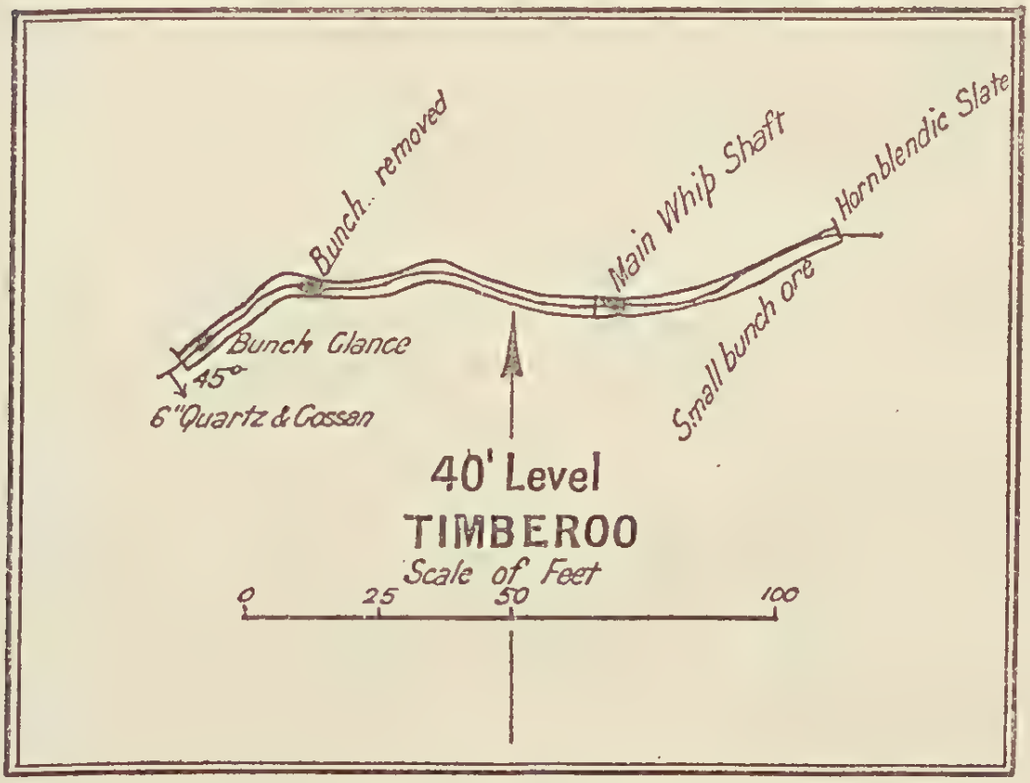
DEVELOPMENT.

The workings comprise two potholes, three opencuts, and five shafts.

One of the potholes lies 1 ch. north 30° west from the main shaft, and the other 2½ ch. north 15° east of the same.

One opencut, 40 ft. long, is at the western shaft; another, 20 ft. long and 8 ft. deep, is 4 ch. south of the main shaft; and the third (continued down as a stope) extends 20 ft. west and 20 ft. east from the main shaft itself.

The western shaft is on the boundary, about 5 ch. from the north-western corner. It is 35 ft. deep, and inaccessible.



The main whip shaft lies 3 ch. to the east. It is 3 ft. 6 in. by 7 ft. in the clear and 54 ft. deep,* further sinking being prevented by influx of water—viz., 1,400 gall. per hour.† On the 45-ft. level crooked drives have been carried 45 ft. eastwards and 65 ft. westwards, and the ground has been stoped out for up to 20 ft. east and from 12 to 20 ft. west of the shaft.‡

Pettit's three old shafts lie 9 ch. east-south-east of the whip shaft. Two are 20 ft. deep and ½ ch. apart; and the third is 25 ft. deep and lies ½ ch. north-east of the first.

The mine had been idle for some time, but three men arrived on the day of my visit to begin work.

Output.

1904	...	78 tons carrying	30%	copper
1905	...	24 ,, ,,	50%	,,
1906	...	24 ,, ,,	51%	,,
Total	...	126 ,,		

Ore-bodies.

There would appear to be at least three parallel lines here, along which ore-bodies have been located at intervals. These lines have a generally east-north-east strike in both the Mount Minde freehold and

* The Warden reported it to be 90 ft. deep in Jan., 1907.

† This increased to 3,000 gall. per hr. at 63 ft. depth.

‡ A winze has also been sunk 13 ft. (16/3/07) at 30 ft. from the shaft in the western drive 45 ft. level.

the Timberoo lease, and may be continuous through the two, though the ore-bodies are lenticular and limited in their horizontal extent, and those in separate workings appear to have no connection.

The occurrence of diorite to the east of the lease is to be noted, and the crops of hæmatite in the same locality are of importance as evidence that the copper deposits are due to regional metamorphism.

The main shaft itself, being timbered, reveals nothing as to the nature of the ore-body.*

Since my visit a pump has been installed and sinking resumed, and from the manager's reports it is learnt that at 63 ft. from the surface the ore-body became confused and irregular, that from 67 to 72 ft. there was no defined lode, and that "at 73 ft. from the surface the vein of pyritous ore passed into the hanging-wall side of shaft, dipping too flat to follow economically." Sinking was then in chloritic schist, and levels were to be opened at 100 ft. from the surface. The water raised contained free sulphuric acid as well as copper; but the manager told me later that, in the shaft below the 40-ft. level, there is a fine body of glance, 3 ft. wide, and that the last 12 ft. of sinking produced 27 tons of ore, carrying 50% copper, and 3 tons of seconds, carrying 20%. The drives afford an instructive section. In the eastern drive only one small bunch of ore is visible, and the end is in chloritic slate; but the parallel slickensided partings of a shear-zone have been followed in the western drive to the west-north-west, west, and then south-west—any dip which does exist being to the south. On most of these from 1 to 6 in. of gossan is found, and every now and then a bunch, up to 18 in. wide, of high grade chalcocite. Sometimes the parting dies out, and the gossan is then found to continue on an adjacent one. The whole is promising for permanence in depth, but no considerable body of ore has yet been proved. Owing to the drive having been half-filled with mullock, the floor cannot be seen.† The ore at grass ready for bagging is tile ore, chalcocite-chalcopyrite, chalcocite-bornite, and pyrite; and there is about 1 ton of rich oxide bagged. This is the only mine in the district at which bornite was noticed. Another unique occurrence is that of crystal aggregates of a form of light-green hydro-mica in the gossan. The crystals are sometimes $\frac{1}{4}$ in. in diameter, and the laminæ, which are easily separated, are slightly elastic.

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* The Warden reported 3 ft. glance at 35-ft. level (2/2/05), and later that 27 tons of 50% ore had been obtained in sinking from 29 ft. to 54 ft. (6/1/06).

† The manager, in his report (5 May, 1906), refers to "the solid ore-body rising to the bottom of the level, thence merging into gossan, containing nodules of copper glance," and further states that in driving from 56 ft. to 62 ft. 1 ton of 45% ore was obtained, while 8 tons of 50% ore were produced in driving from 30 ft. to 65 ft. Underhand stoping has been carried out below the 45-ft. level—6 tons of 50% ore being culled for the first fortnight. In the winze below the 45-ft. level, at 6 ft. depth, the "pyritous ore-body" was 3 ft. wide, and assayed 40% copper; at 9 ft. depth, the ore-body, 4 ft. 6 in. wide, bulked 42% copper, and 10 tons of 50% ore had been raised, while 10 tons of high grade ore were obtained in sinking the last 4 ft.

The western shaft and opencut seem to be on a separate lens to either the Mount Minde or Timberoo main shafts. The shaft was opened on 15 in. cupriferous gossan running vertically east 10° south, and pinching in the western end of the opencut to 6 in. The country rock is horneblendic schist and slate, that on the tip containing quite 5% of white, sintery lime. There is 10 tons of ore at grass, probably containing 10% copper (as malachite).

Some very fair ore has been raised from the southern opencut, and the 3 tons of seconds at grass—malachite and tile ore in limonite—should yield 20% copper.

The pothole to the north-west of the main shaft exposes a vein of quartz dipping 80° to the south 30° west, in chloritic schist. The quartz is mostly barren, but some bunches of malachite and tile ore in limonite have been broken into.

In the eastern pothole a vein, 2 to 6 in. thick, of gossan, with some tile ore and carbonate, has been found.

Pettit's workings are on small lenticular bodies in quartz, and, from surface indications, are not worth much attention.

The south-western shaft is on a blow of quartz striking east-north-east and vertical or underlying very steeply to the south. The quartz is 2 ft. 6 in. wide at the surface, and increases to 4 ft. in width within 5 ft. of the surface. Only the faintest stains of copper can be seen.

Pettit's south-eastern shaft was sunk in altered speckled rock 5 ft. south of the same crop, where it is slightly cupriferous. Several large blocks of calcite were raised, the mineral presumably being associated with the quartz.

In Pettit's northern shaft a lens of quartz 10 ft. long strikes east-north-east, and at the surface is 12 in. wide, but pinches downwards. Some dense limonite, with a small percentage of malachite, must have come from the lower part of the shaft, and it is understood that some ore has been shipped from here.

Resurgam (M.L. 399).

Mgr., Pettit.

Location, Area, Etc.

The Resurgam adjoins the Mount Minde Freehold on the west. Its area is 3 ac. This appears to be the Duffer claim.

Literature.

(8) Mr. Gibb gives the following analyses (Government Analyst):—

(r) Rejected (three-fourths) from ore raised—

Copper	=	12·6
Silica	=	51·3
Iron protoxide ...	=	15·3
Alumina	=	7·0
Lime	=	9·2
Sulphur	=	0·5
		95·9

(s) Selected for shipment—

Copper	=	31·5
Silica	=	18·4
Iron protoxide ...	=	20·4
Alumina	=	1·5
Lime	=	tr.
		71·8

Development.

Much trenching has been done, for no result, to the west of the main workings, where there are two shafts: one, 45 ft. deep, lying 2 ch. south-west of the north-eastern corner, reaching water-level; and another 33 ft. deep, 25 ft. west-south-west of the above. The ground between the two shafts has been stoped out. There was one man on the ground at the time of my visit, but little work has been done during the last twelve months.

Output.

		100 tons from 45 ft. shaft, aver. 35 to 36% copper (*fide* Mr. Pettit).
1904	...	51 tons (Duffer)
Total		151 tons.

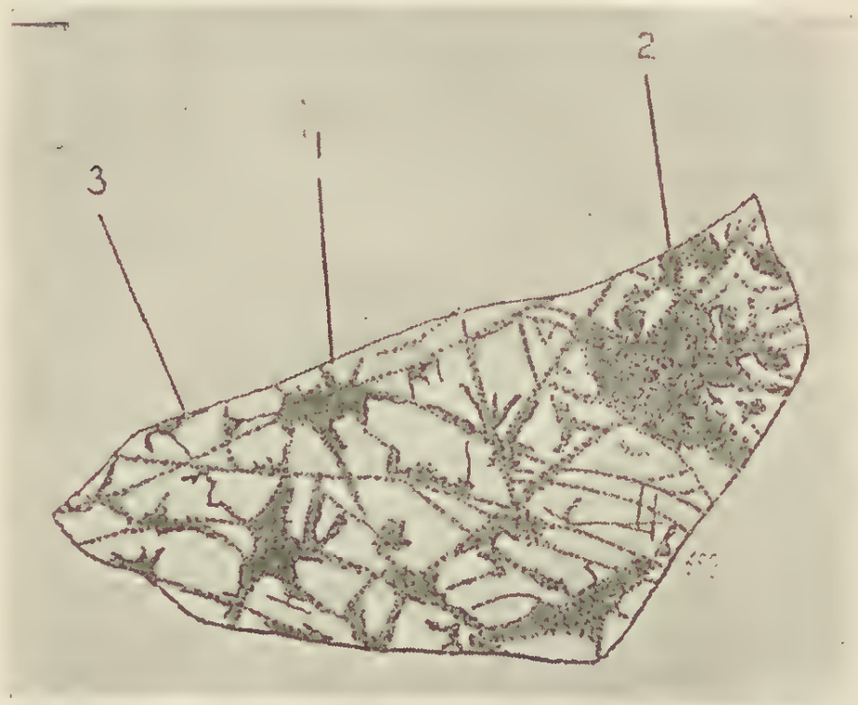


Fig. 20 (twice natural size).—enriched ore, resurgam.

1. Chalcopyrite
2. Limonite
3. Chalcocite.

Ore-bodies.

The eastern and southern shafts are on a formation, running east-north-east in highly altered chloritic slates. The former was sunk on a rich shoot, 4 ft. wide, the copper ore being in layers 2 ft. thick separated by sinter (locally considered a very good sign for the finding of rich ore), and ill-defined from the country. It is asserted that 100 tons of 35% ore have been raised from this shaft, but very little ore, except some patches of leached chalcopyrite, can now be seen. The ore has been broken down for 10 ft. east of the shaft, where dense brown siliceous limonite occurs at the surface.

Half-way between the two shafts a tongue of country comes in, and a branch of the ore-body running off to the west has been stoped out for 15 ft.

In the southern shaft lumps of glance have been found irregularly scattered through a limy formation over a width of 6 ft. north of the shaft, but the present faces are barren. One specimen obtained shows plainly the alteration of chalcopyrite into limonite and glance. The chalcopyrite appears to have cracked in all directions, allowing of the formation of thin films of limonite, and subsequently the isolated particles of chalcopyrite have been replaced by chalcocite to a greater or less extent. (See Fig. 20.)

Cecil (M.L. 400)

Mgr., Lobeston.

Location, Area, Etc.

The Cecil is ½ mile west-south-west of the Mount Minde.

Its area is 5 ac. Not visited.

One shaft is shown on surveyor's plan.

Marguerite (M.C. 151).

Mgr., Grenier.

Location, Area, Etc.

The Marguerite lies about 1 mile south of the Mount Minde freehold.

Its area is 200 ft. × 350 ft. Apparently abandoned.

Development.

The main workings, at the northern end, comprise three shafts and a pothole, the last being at the extreme north and only 10 ft. deep. A shaft, 10 ft. to the south of the pothole, is 25 ft. deep (inaccessible); 20 ft. beyond is the main shaft, 35 ft. deep; and another 25 ft. deep, and inaccessible, lies 10 ft. further south. To the south outside of the claim and 5 ch. distant is a trench, and 2½ ch. beyond it is a hole, 5 ft. deep, 1 ch. south-south-east of which is a 10 ft. shaft.

Output.

1904	...	3½ tons (Grenier), shipped
06	...	8½ „ („). „
Total		12 „ „

Ore-bodies.

There are here three detached outcrops, which, though lying on a north and south line, are parallel and probably on distinct zones, striking north 5° east, and dipping 10 in 1 h. to the west.

The crop at the main shaft consists of bunches of cellular gossan, 6 in. wide, but at the bottom there is a body of limonite, 15 in. wide at the southern end and 6 in. wide at the northern, with walls not slickensided but well defined. This is most promising, and sinking should be continued.

The northern shaft is in chloritic schist country, carrying bunches of 40 to 50% ore associated with quartz and ferro-calcite, both of which are pierced by long thin needles of black tourmaline.

In the southern shaft much black calcite was met, besides which some 25% ore is reported to have been shipped.

The 5 ft. hole to the south exposes 2 ft. 6 in. of cellular bluish gossan—almost certainly leached copper ore—dipping 70° to the west-north-west in laminated country. The pothole to the south of this proved only schists, being too far to the east, but the trench to the north shows quartz strongly stained by malachite.

This claim is on the line of strike of the Brilliant crop, the only other striking north and south in the Slaty Creek catchment.

Geology.

The north and south strike and the inter-crystallisation of the quartz and calcite are indicative of the ore bodies occurring in originally calcareous sedimentary beds, now tilted into a vertical position. The occurrence of tourmaline in the quartz and calcite is evidence that during the metamorphism pneumatolysis took place owing to relief of pressure. The copper ores have therefore most likely been derived in this case from deep-seated igneous rocks in process of cooling.

Ida (M.C. 179).

Mgr., Dannes.

Location, Area, Etc.

The Ida is about ½ mile west-by-south from the Two Mile well.

Its area is 200 × 350 ft.—one man's ground.

One shaft, 20 ft. deep, is in process of being sunk.

Output.

3 tons shipped, carrying 38 % (*fide* Mr. Dannes).

ORE-BODY.

The shaft was sunk on calcite, ferro-calcite, and limonite, with occasional small bunches of chalcopyrite, especially on the eastern side of the shaft. The ore-body, which in the shaft is 2 ft. thick in one place, appears to pinch out in the sump. It strikes east 10° north, dipping 80° to the south. The country rock is clay schist, the footwall being much indurated.

Unnamed (M.C. ?).

Mgr., McEvoy.

LOCATION, ETC.

This abandoned claim is about ¼ mile west-south-west of the Two Mile well on the Gorge-Duck Creek road, and about 2 miles east of the Mount Minde freehold.

Only trenches have been opened here.

ORE-BODIES.

The ore-bodies here are of little economic import, but the mineralogical associations are most interesting. Chalcopyrite has been found in small quantities with stains of malachite, and set in the former are crystals of quartz pierced by radiating needles of tourmaline. Mr. McEvoy here found one small patch—in all about 4 lb. in weight—of bismutite, a specimen of which given me is light-green in colour, is coated with red clayey gossan, and encloses crystals of quartz.

Brilliant (M.C. 159).

Mgr., Savage.

LOCATION, AREA, ETC.

The Brilliant lies about 2 miles south of the Mount Minde freehold, and 1½ mile north-west of the Two Mile well.

The area is 400 ft. × 350 ft. Apparently abandoned.

DEVELOPMENT.

The main shaft, at the northern end, is 55 ft. deep. At the 45-ft. level a drive runs 20 ft. north, and a monkey shaft at the end, 10 ft. deep, has been filled in. The only other workings are two potholes 2½ and 5 ch. to the south.

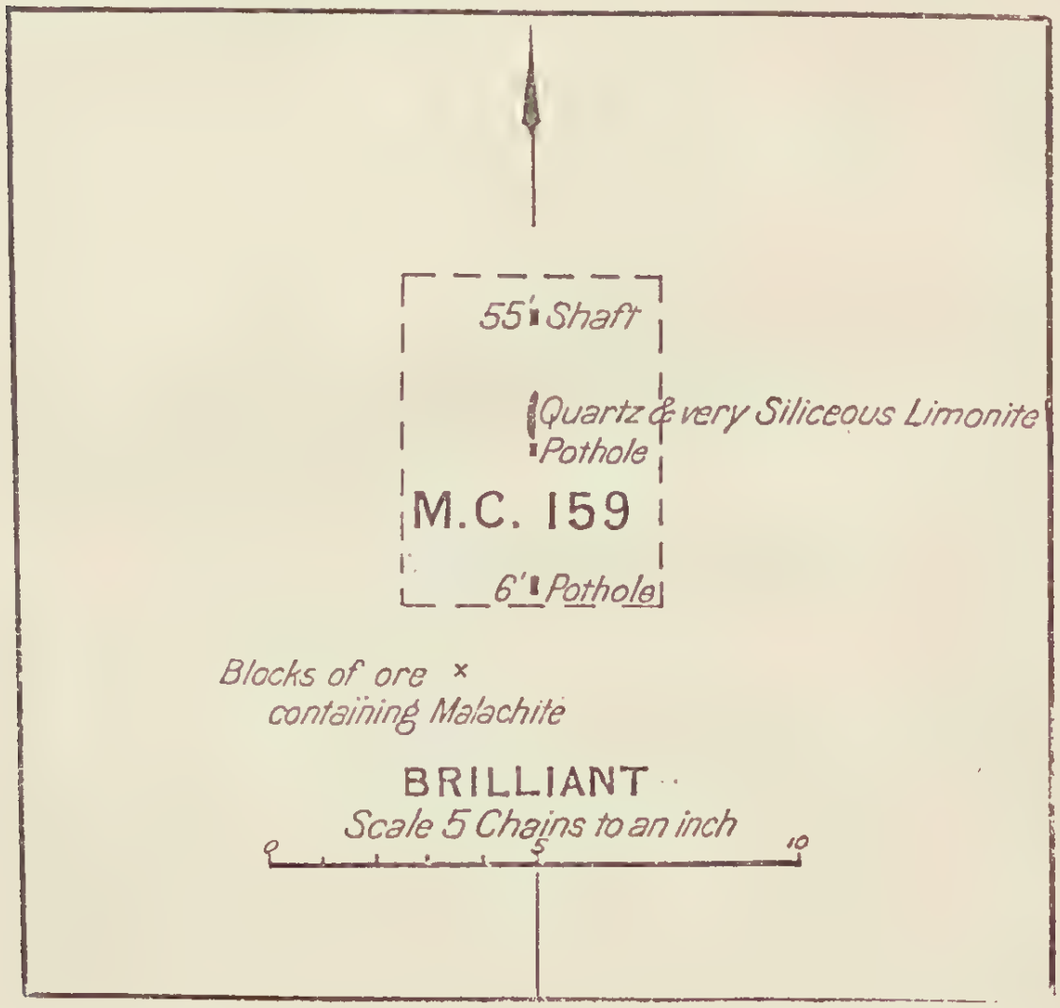
OUTPUT.

40 tons shipped, carrying 26 to 32% (*fide* Mr. McEvoy).

ORE-BODIES.

As mentioned, this and the Marguerite are the only north- and south-striking ore-bodies in the Slaty Creek district, and are perhaps

on the one line, though there are no intermediate workings. The country rock is chloritic schist.



The main outcrop of quartz and siliceous limonite is over a chain south of the shaft, and no work has been done on it, though two bags of medium-grade ore were got from the pothole at the southern end. The southern pothole exposes cellular gossan 18 in. wide and dipping 70° to the west, barren, but well worth prospecting by sinking.

The shaft was sunk in quartz and cellular gossan (göthite and limonite), the latter containing crystallised malachite and in the denser portions chalcopyrite, but no quartz; the latter, which occurs chiefly on the southern side of the shaft, being barren-looking, but its cavities lined with crystals and stained by gossan. Along the drive the body of gossan and quartz is 4 ft. wide, but in the end it has pinched to 2 ft. 6 in. The walls here are well defined, but not slickensided. A shoot of ore, rich in copper, pitched from the shaft, at 10 ft. depth, to the end of the northern drive, its inclination being thus 1½ in 1. The whole of the tip, approximately 100 tons, is rich in tile ore and malachite, and should average 10% copper, while 10 tons of 20% ore could easily be picked out. Only two tons of firsts are paddocked, the remnant of 40 tons lately shipped.

The character of the walls, which are in places 5 ft. apart, is not unpromising for permanence in depth, and the nature of the ore is strongly indicative of there being much richer copper ore below the present workings.

Unknown (M.L. ?).

Mgr., Allis.

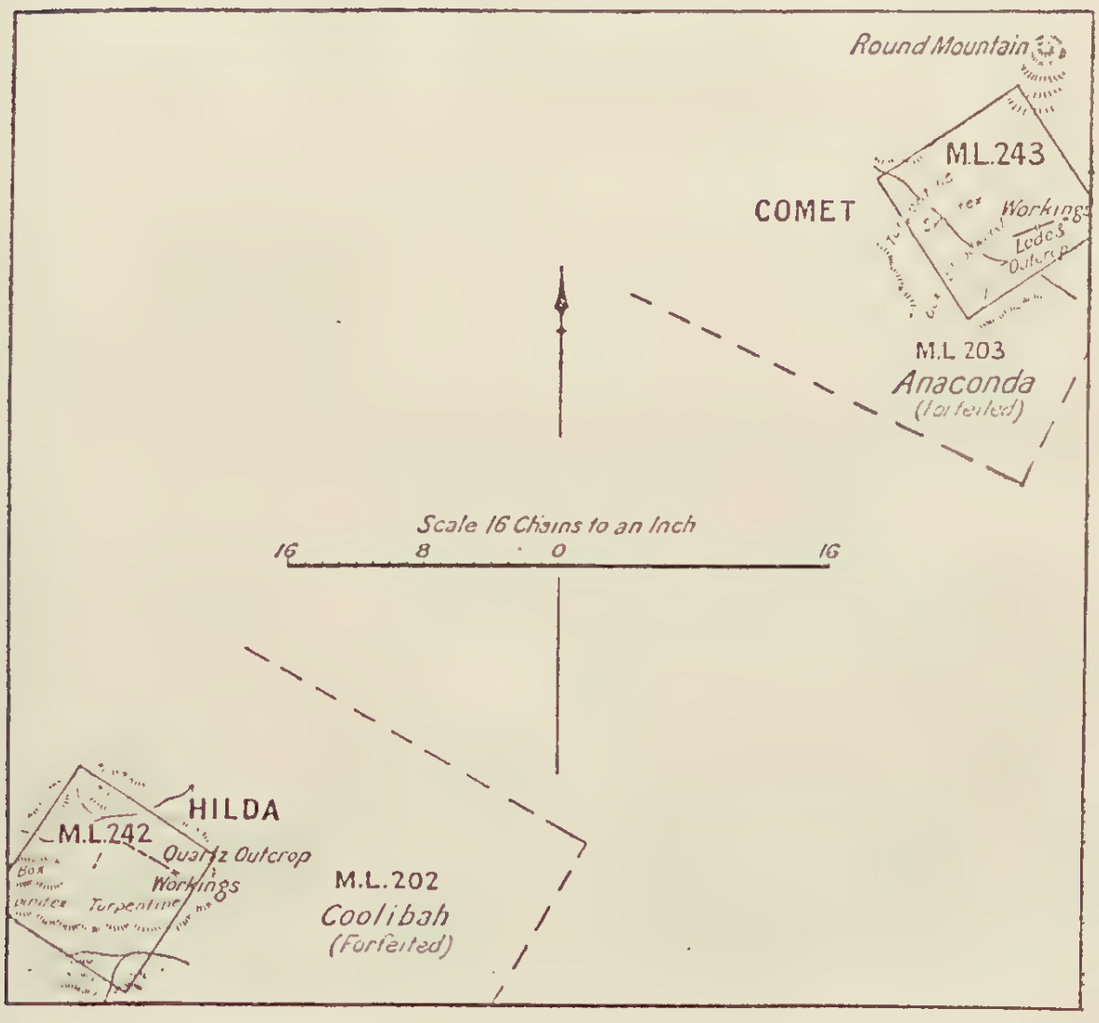
Location, Area, Etc.

This lies ½ mile south-west of the Gorge Hotel, which is 16½ miles south-west-by-south of Cloncurry.

Several potholes have been opened at some time in the past.

Ore-bodies.

The potholes lie on an east and west line, and, in the eastern-most, the ore body is seen to dip 80° to the south. The eastern cut is in a bunch of siliceous copper-bearing iron ore, 10 ft. in length and 2 ft. 6 in. in total width. Of this the half on the hanging-wall is chiefly flaky hæmatite (specularite) and limonite, but the hanging-wall half of the lode may run 20% copper.



HILDA GROUP.

The Hilda Group takes in the few scattered holdings on the southern branch of Slaty Creek, followed by the Boulia road.

Comet (M.L. 243).

Mgr., Matheson.

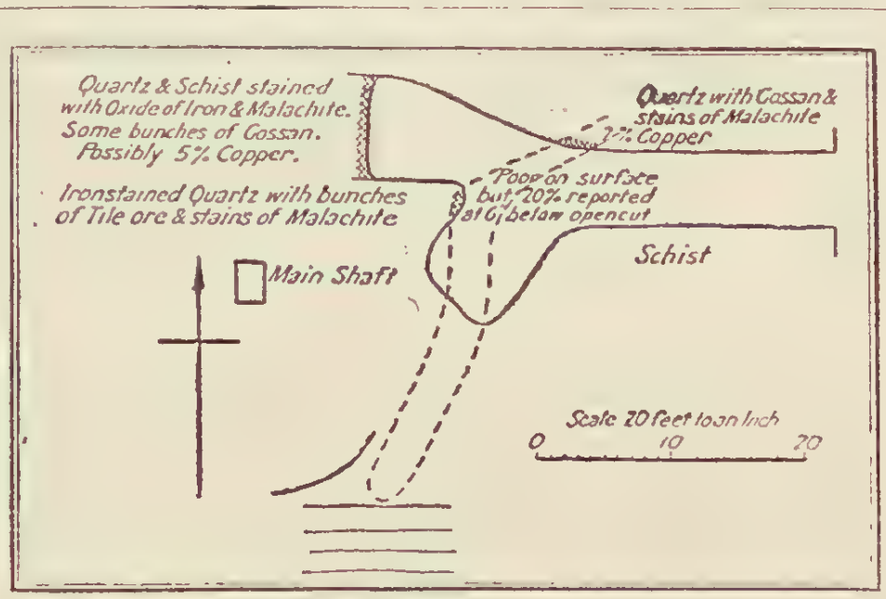
LOCATION, AREA, ETC.

The Comet is 20 miles south-west-by-south of Cloncurry, and about ½ mile west of the Boulia road, 3 miles from the Gorge Hotel.

Its area is 10 ac. This is part of a forfeited lease known as the Anaconda. It is now the property of the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

The main excavation is an open cut, 6 to 8 ft. wide, 2½ ch. west of the eastern corner of the lease; it runs 35 ft. west and 7 ft. from the end there is a branch, 10 ft. long, to the south-west.


Quartz & Schist stained with Oxide of Iron & Malachite. Some bunches of Gossan. Possibly 5% Copper.
Quartz with Gossan & stains of Malachite 1% Copper
Poor on surface but 20% reported at 6' below opencut
Ironstained Quartz with bunches of Tile ore & stains of Malachite
Main Shaft
Schist
Scale 20 feet to an inch
0
10
20

SKETCH PLAN OF WORKINGS, COMET.

A vertical shaft was being sunk in October last, 25 ft. west-south-west of the central tongue of the cut; and from it it was proposed to drive back to the rich shoot of ore.*

ORE-BODIES.

The ore is found in a belt of schist, striking about west-south-west, which can be followed to the western boundary of the lease from the open cut, a trench at 1½ ch. distance exposing 18 in. iron-stained quartz with some malachite. In the western end of the

* From the manager's reports it is learnt that a crosscut 12 ft. long was put across it at the 50 ft. level, a drive 10 ft. wide being then carried east 22 ft. (30th March, 1907). The shaft has also been sunk a total depth of 58 ft. (27 May, 1907).

opencut there is 8 ft. width of schist and quartz, stained by iron oxides and malachite, and carrying some bunches of gossan. Over the whole width it should average at least 5% copper. Another body of richer ore comes in from the north-east, and has been followed in the south-western branch of the cut. On the northern side of the cut it is 2 ft. wide, and consists of quartz with gossan and stains of malachite, the copper content perhaps reaching 2%; but in the central tongue of the cut can be seen iron-stained quartz, with bunches of tile-ore and stains of malachite, somewhat richer. This body has been trenched to 6 ft. below the floor of the opencut and filled in, but Mr. Matheson informed me that, though so poor on the surface, a sample from the bottom of the trench yielded 20% copper.*

There are 100 tons of ore from the open-cut at grass. It consists of very siliceous schist, all carbonate-stained and containing bunches of tile ore, fragments of quartz being often cemented by limonite, in which some of the original chalcopyrite can be distinguished. It is expected to yield between 10 and 15% copper.

Nothing of promise is to be seen here. The quartz has presumably segregated, during the metamorphism of the country into chloritic schist, especially along crush-zones which have later allowed circulation of cupriferous solutions. It is possible that some hundreds of tons of comparatively low-grade and siliceous ore may be broken down here, but there is no likelihood of payable ores being found to descend.

Hilda (M.L. 242).

Mgr., Matheson.

Location, Area, Etc.

The Hilda is about 1 mile west of the Comet. The country is low rolling ridgy, and it is covered with stunted box and gum and with scrubby heath.

Its area is 10 ac. This lease is the property of the Willcocks Cloncurry Development Syndicate.

Development.

There is only one shaft on this lease. It was sunk 27 ft. by Mr. Allis, the former holder, and has been continued 3 ft. by the syndicate. It is vertical for 20 ft., and then underlies 3 in 1 to the northwards.

The manager's reports to the end of March, 1907, state that the shaft has since been sunk a total of 64 ft., and levels opened east and west at the 60-ft. level.

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* Since my visit the shaft has reached the hanging-wall of the formation at 46 ft., and at 58 ft. was in iron oxides, quartz, and hard copper carbonates. The ore-body has been proved to be 10 ft. wide in the crosscut on the 50 ft. level, 10 tons of 20% ore having been produced, the average contents of the whole being therefore 5%, though the first 4 ft. averaged 25%. In the eastern drive the face at 6 ft. distance from the crosscut assayed 9% over a width of 10 ft.; but at 12 ft. the 5 ft. on the hanging-wall assays 20%, the footwall portion being very siliceous and low in copper; at 18 ft. half the product was rejected, leaving 18% ore, and the face at 22ft. is unchanged.

Ore-bodies.

The outcrop strikes west 30° north. For 1 ch. north-west of the shaft quartz, with much lime and some gossan, is to be seen, when there is a break for ½ ch., and then another crop for a similar distance, beyond which there are only a few small lenses of quartz on the line of strike. For 2 ch. to the south-east of the shaft limestone, quartz, and quartz-bearing schist crop on the line, giving little indication of the rich ore met in the shaft. The country north of the shaft shows abundant epidote, and, though resembling an altered volcanic, is apparently a metamorphosed sedimentary.

In the shaft the country is indurated near the lode, but the walls are not slickensided, though well defined, and there is 2 to 3 in. of earthy lime, with inclusions, on the footwall from top to bottom of the shaft. Much quartz was found with the limonite for about 15 ft. from the surface. At the shaft bottom the ore-body—mostly dense limonite with disseminated malachite and cores of tessellated chalcopyrite and chalcocite, and of almost pure chalcocite—gossany in parts, is 3 ft. wide,* and from the last 3 ft. of sinking 8 tons of 15% ore were paddocked.† The gossany parts of the ore contain a considerable amount of manganese dioxide, and a few drusy calcite crystals were noticed. The ore in the lower part of the shaft is noticeably free from quartz, and will therefore be valuable in smelting mixtures, even though yet comparatively low in copper.

Mascotte (M.C. 319).

Mgr., Corney.

Location, Area, Etc.

The Mascotte is about 1 mile south-east of the Comet.

Its area is 600 ft. × 350 ft.

Development.

The workings comprise one shaft, 10 ft. deep, in the centre of a trench, 20 ft. long and 3 ft. deep; Allis's old trench, 10 ft. long and 5 ft. deep, 1½ ch. west of the shaft; and a pothole, 3 ch. east of the shaft.

Output.

1898 ... 3½ tons shipped, carrying 68% copper (*fide* Mr. Corney).

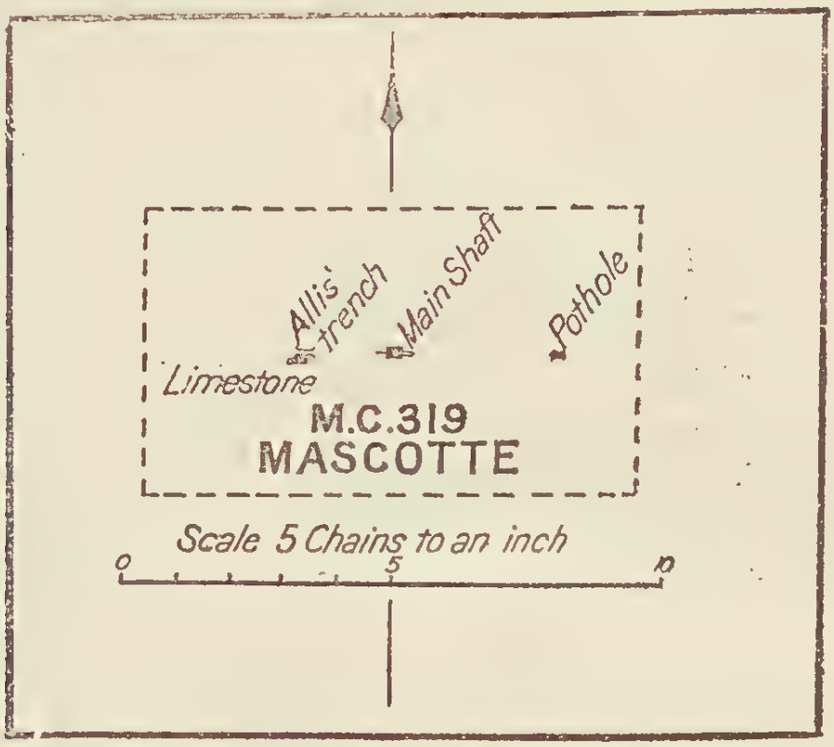
Ore-body.

The strike of the ore-body is east 15° north. It makes little crop at the surface, there being only one exposure of cupriferous

* The manager's reports tell that at 36 ft. and 43 ft. depth the lode is still 2 ft. 6 in. wide, at the latter point assaying 14% copper, but, at 58 ft. depth, there is only 12 in. siliceous ore. The drives on the 60 ft. level were begun in soft calcareous formation, 2 ft. wide, with bunches of ore, but at 6 ft. from the shaft it appears to have been leached of copper.

† The total ore raised in sinking the shaft to 58 ft. was 40 to 50 tons, averaging 15% copper.

gossan betwen the old trenches. The country is schist rather indurated and jointed near the ore-body.



The trench at the main shaft exposes up to 3 ft. width of ferruginous calcite, containing patches of quartz and chalcocite; but in the shaft the ore began to improve at 5 ft. below the surface, and in the bottom is exposed very good tile-ore (much resembling limonite) and malachite, with some chalcopyrite altering into chalcocite. The firsts paddocked amount to 2 tons, and are estimated to contain 40% copper, while the seconds, ½ ton, should yield 25%.

Allis's old trench, which is 5 ft. north of a small crop of limestone, and from which some splendid cuprite encrusted with malachite and embedded in powdery gossan has been taken, proves the ore-body exposed by it to pinch out within 10 ft.

In the eastern pothole can be seen iron-stained schist and gossan with tesselated limonite—very low in copper. This ore should be sunk on, as it is likely to improve beneath the surface.

Hermit (M.C. 339).

Mgr., Corney.

Location, Area, Etc.

The Hermit lies about 1½ mile east of the Mascotte.

Its area is 600 × 350 ft. It was not visited.

Output.

1906 ... 6 tons shipped (Press).

Ore-body.

The ore-body is said to be similar to that of the Mascotte.

CORELLA RIVER.

The mines are scattered over an area extending 20 miles from north to south and 10 miles from east to west, being located chiefly on western and southern affluents of the Corella River. Most of them were under exemption, and, being deserted, no attempt was made to locate and examine them.

The country is mostly mountainous, is badly watered, is poorly timbered, and is highly uninviting for any purpose except mining.

A dray road has now been opened from Duck Creek to the more important mines, which may also be reached by following up the Corella River from the Argylla road, the distance from Cloncurry to the Springs Camp, a well known centre, being approximately 50 miles by either route, though by an air-line west-south-west it is only 34½ miles.

EAST CORELLA GROUP.

This group is of little import, including only the Wakeful besides the claim here noticed.

Lady Franklin (Extd. M.C. 122).

Mgr., Hinds.

LOCATION, ETC.

The Lady Franklin is situated on Franks Creek, 14 m. west of the Gorge Hotel. The claim could not be visited.

DEVELOPMENT.

No. 1 shaft is 40 ft. deep (December, 1906), and No. 2 shaft is 18 ft. deep (January, 1907).

OUTPUT.

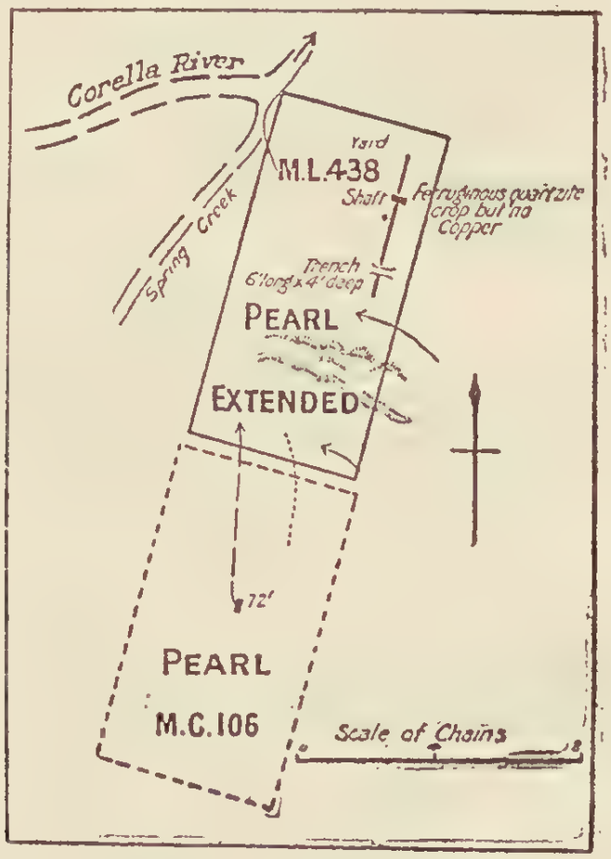
1903	... ...	20	tons raised (reported)
		41⅗	„ shipped.

ORE-BODIES.

Early in 1906 it was reported that No. 1 shaft was "on 7 ft. of silver-grey ore," and that No. 2 shaft was on blue-grey ore. At that time 15 tons had been raised for despatch.

PEARL GROUP.

The group comprises the eastern leases on the Corella River, including the Imperial and Fairy, not mentioned below.



Pearl Extd. (M.L. 438).

Mgr., Lawes.

Location and Area.

The Pearl Extended is located on the eastern side of the junction of Jimmy's Springs Creek and the Corella river, 3 miles north-north-east of the Springs Camp.

Its area is 5 ac.

Development.

The workings comprise a trench, 6 ft. long and 4 ft. deep, near the middle of the eastern side, and a shaft, 18 ft. deep, 2 ch. to the north, sinking having been stopped by water.

Output.

1906 ... ... 1 ton at grass, carrying 5 % copper.

Ore-bodies.

To the north of the shaft barren ferruginous quartz outcrops, striking north by east. The shaft has passed through a body of gossan 18 in. wide dipping 3 in 1 to the westwards, and well worth following on the underlie.

The trench exposes a cupriferous gossany formation, 12 in. wide, on the line of strike of the gossan cut in the shaft, and under a gossany formation 4 ft. wide dipping west-by-north. About 1 ton of 5% ore is at grass here.

Pearl (M.C. 106).

Mgr., Lawes.

Location and Area.

The Pearl adjoins the Pearl Extended on the south.

Its area is 600 ft. × 350 ft.

Development.

A shaft, underlying 3 in 1, has been sunk in the centre of the claim to a depth of 72 ft., but was not accessible to me below the 40 ft. level, where there is a drive for 12 ft. to the north. A stope extends 10 ft. southwards from the shaft to 54 ft. below the surface. A second shaft, 15 ft. deep, lies in the south-western corner of the lease.

Output.

		30 17/20	tons shipped,	carrying from 32 to 37 % copper	(*fide* Mr. Lawes)
1905	...	14	,,	,,	(by Lawes)
		45 19/20	,,	,,	,,
Total	...	50	,,	,,	

Ore-bodies.

Little outcrop can now be seen at the shaft, but ore from near the surface shown me consists of chalcocite, limonite, and pyrite. The copper ore occurs as gossany bunches and leaders in crushed kaolinised schist. At 10 ft. below the surface there is 2 ft. 6 in. width of carbonate-bearing gossan. The schist is barren in the shaft between the 40 ft. level and water level (at 50 ft. depth) where some chalcopyrite is said to have been found, while glance, coated with amorphous secondary sulphide, was shown me from the shaft bottom. The southern drive at the 54 ft. level is said to be in oxidised ore 2 to 4 ft. wide, and 7 tons of pay ore were obtained from the first 7 ft. of driving. The whole formation underlies 3 in 1 to the west 12° south. It has been proved to be cupriferous only over a length of 20 ft., and it appears to be a distinct ore-body from that being worked on the Pearl Extended.

A second parallel outcrop in the south-western corner of the lease was not inspected.

Brydon's (M.L. 672).

Mgr., McCallum.

Location, Etc.

Brydon's lies 1 mile north of the Pearl and 4 miles north-by-east of the Springs Camp.

Its area is 40 ac. The ground was deserted when visited in December.

Development.

The main shaft is 20 ft. deep. Lidster's shaft, 20 ft. to the south-west, is 15 ft. deep and has a stope running 6 ft. to the east. Besides these there are numerous other potholes on the lease. No work has been done here lately.

Output.

1904	...	8	tons shipped,	carrying	20%	copper.
,,	...	4	,,	,,	,,	25%	,,
1906	...	$4\frac{17}{20}$	,,	,,			
Total	...	$16\frac{17}{20}$	,,	,,			

Ore-bodies.

The main shaft is in an irregular gossany formation, chiefly silicified country (sedimentary), carrying bunches of carbonates. At the eastern side of the shaft the country is stained over a width of 5 ft. adjacent to a 3 in. band of gossan, and at the shaft bottom over a width of 12 ft., but is not promising. The whole tip from this shaft would probably yield 2% copper.

Lidster's shaft is on a bunch of limonite, replacing chloritic schist and stained by malachite. Lidster shipped 4 tons of 25% ore from here, and there are now 5 tons seconds at grass.

Spring Peaks (M.L. 562).

Mgr., Allis.

Location, Etc.

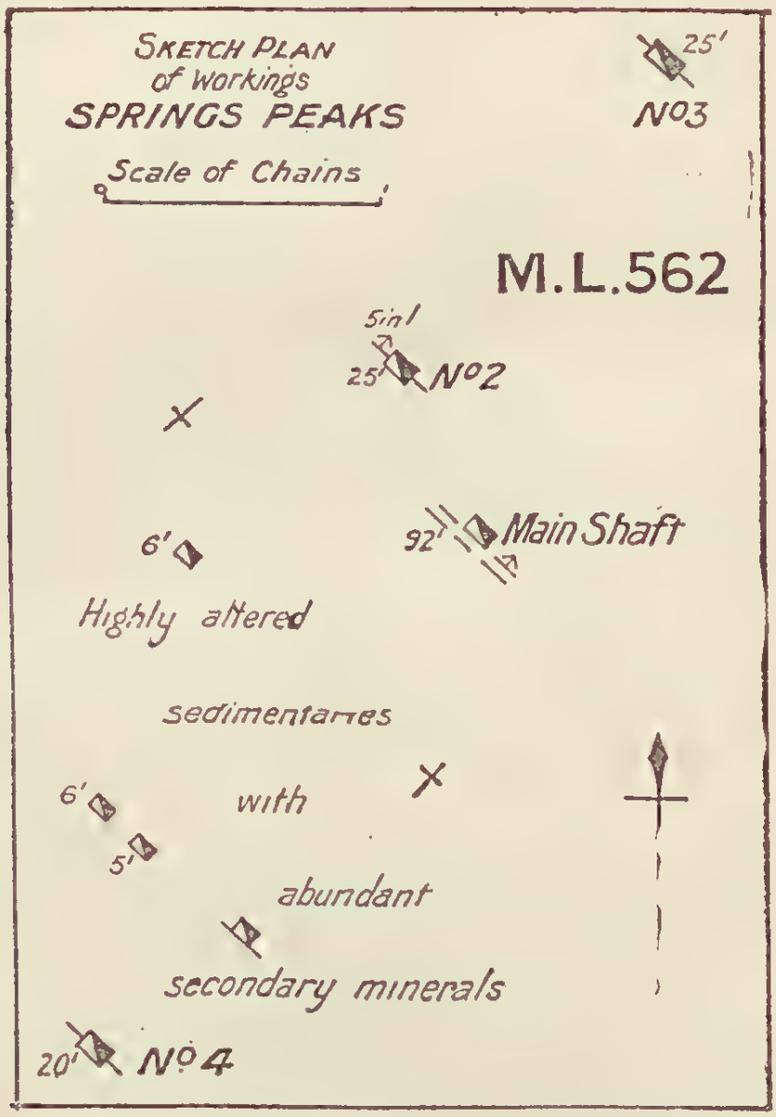
The Springs Peaks lease is located on the ridge-top east of Jimmy's Springs Creek, and 34 miles west-south-west of Cloncurry. The lease is $\frac{1}{2}$ mile east-south-east of the Springs Camp on the Cloncurry road, and the brace of the main shaft is 150 ft. above the camp. The lease is in the midst of a worn-down mountain range being surrounded by rounded hills and ridges of approximately the same elevation. These hills are bare of timber, except for a few scattered mountain gum, there being little soil and that of a poor quality.

Its area is 20 ac. Prior to my visit it had been under option to the West Cloncurry Copper, Limited, but some dispute had caused the stoppage of all work in November last.

Development.

The main shaft near the centre of the lease is 92 ft. deep. No. 2 shaft, 40 ft. to the north-north west of the main shaft, is 25 ft. deep and inaccessible. No. 3 shaft, 2 ch. to the north-north-east of the main shaft, is 25 ft. deep and also inaccessible. No. 4 shaft, 20 ft. deep and inaccessible, is 2 ch. to the south-west of the main shaft. Besides the

shafts, there are 4 potholes, 5 to 6 ft. deep, one of them 1 ch. west of the main shaft and the three others on a north-west line 1½ ch. south-west of the same.



Ore-bodies.

The Springs Peaks is in a region of highly altered sedimentary rocks, which, at the camp, contain much epidote, but the bedding planes can be distinguished, the strike being north 33° east. The slates on the lease are also highly altered, and many secondary crystalline minerals have been developed both at the main shaft and near the pot-holes to the south-west. At the latter place felspar occurs in distinct crystals, together with much hypersthene altering to a bronzed serpentine, a little opaque white allotriomorphic quartz, greenish-yellow granular epidote, and occasional grains of hæmatite. Chalcopyrite is found in the finer grained parts apparently replacing hypersthene, but chrysocolla veins are plentiful in the most coarsely crystalline rock.

Four separate lines outcrop on this lease, within a distance of 4 ch., but none of them can be traced for any distance along the

surface. The main shaft was put down with the idea of proving these at a depth, and at 60 ft. below the surface struck a fifth formation striking east 40° south and dipping north-eastwards, within a few degrees of vertical. Its thickness is generally less than 12 in. and it comprises chiefly ferruginous, crushed, broken, and powdered country (highly altered crystalline sedimentary). The walls are not slickensided, and the formation seems to be only along a large joint. At 60 ft. depth some bunches of malachite-stained chalcocite, replacing chalcopyrite were met, and several veins of chalcopyrite were cut at 70 ft. depth, one 6 in. wide there branching off the main formation and dipping into the northern side of the shaft. In the lower part of the shaft only occasional splashes and impregnations of chalcopyrite are found, and the seam contracts to 3 in. width, but is again opening out in the bottom, and further bunches of ore may therefore be obtained. There are at grass 3½ tons of ore consisting of chalcopyrite and chalcocite, the former having everywhere a thin coat of secondary sulphide on cracks, besides which there are bunches of the same mineral. The paddock is therefore expected to assay between 30 and 35% copper.

No. 2 shaft was opened on an outcrop of gossan, 2 ft. wide, with ill-defined walls; it is reported to have pinched in the bottom, and can be traced for only 10 ft. south-east of the shaft and 20 ft. to the north-west. It strikes south-east and north-west across the stratification of the country rock, and its dip is 5 in 1 to the north-east. There is about 1 ton of gossan, carrying 5% copper (as silicate), paddocked here, but the whole tip carries chrysocolla and will probably yield 5% copper.

No. 3 shaft exposes a north-west running formation of kaolinised slate carrying malachite, chrysocolla, and tile ore, but without sign of walls, the mineralisation being presumably along a cross joint. The 2 tons of firsts at grass are expected to yield over 30% copper.

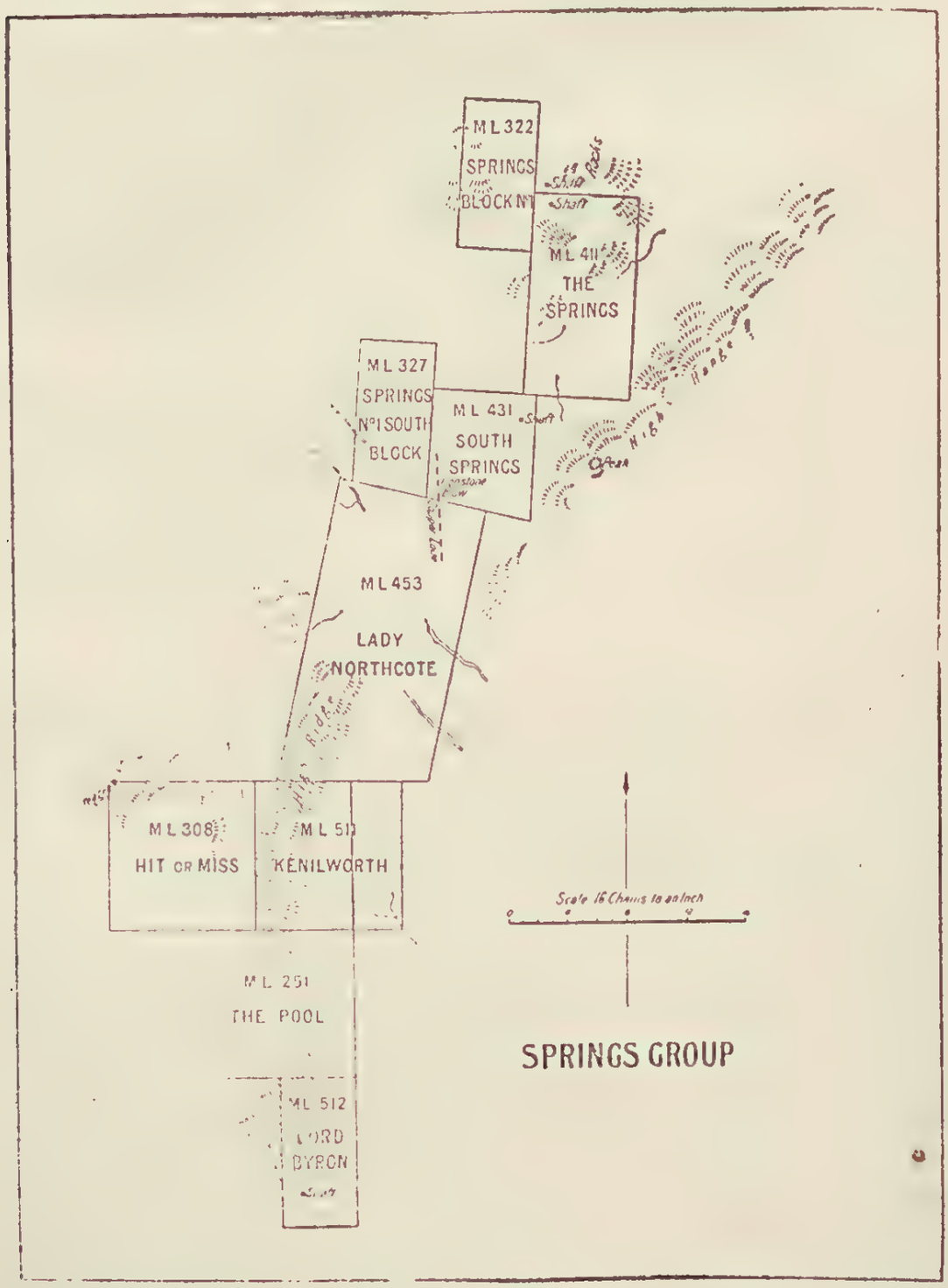
The pothole to the west of the main shaft shows only copper-stained altered slates.

The southernmost of the three holes to the south-west of the main shaft is alongside a 9 in. vertical band of gossany kaolin, the country for several feet to the south-west of which is stained on joints by blue chrysocolla. There is here, as already mentioned, a great development of secondary crystalline silicates. The central hole is in ferruginous kaolinised country with some gossan, but shows no definite lode, though the faces should average 2% copper. The northernmost hole is also in cupriferous and iron-stained country; but 2 tons of cupriferous gossan were obtained here. The 3 tons of rich ore bagged alongside the hole has been "gouged" from different crops all over the lease.

No. 4 shaft is in stained country, adjacent to a north-west striking bunch of ore, 12 in. wide, which has been taken out over a length of 10 ft. There are 3 tons of firsts bagged at the brace, and 4 tons of cupriferous gossan, carrying 10% copper, have been paddocked.

SPRINGS GROUP.

The group includes, besides those described below, the following leases:—Hit or Miss, Pool, Springs Block No. 1, Springs No. 1 South, Springs South, Lady Northcote, Kenilworth, and Ivanhoe No. 1 South.



None of them was visited, as they had been deserted at the end of the year.

Springs (M.L. 411).

Mgr., Entriken.

LOCATION, ETC.

The Springs lies about 1 mile north-west of the camp of the same name.

Its area is 10 ac.

DEVELOPMENT.

A shaft had been sunk 45 ft. in January, 1905.

OUTPUT.

1905 ... 25 tons ore shipped.

ORE-BODY.

Lode runs nearly north and south and averages over 6 ft. in width. "It is grey-ore* and of first class quality." "An almost solid body of grey-ore* shows across the width of the shaft at that (45 ft.)

Ivanhoe (M.L.).

Mgr., Hare.

LOCATION, ETC.

The Ivanhoe lies south of the Springs lease.

DEVELOPMENT.

There are a cut, 15 ft. long and 6 ft. deep; a trench, 30 ft. long and 3 ft. deep, on the eastern side of the hill; and a shaft, 10 ft. deep, west of the trench.

OUTPUT.

1904	...	4 tons shipped
		8 ,, seconds at grass
1905	...	15 ,, at grass, low grade.

ORE-BODY.

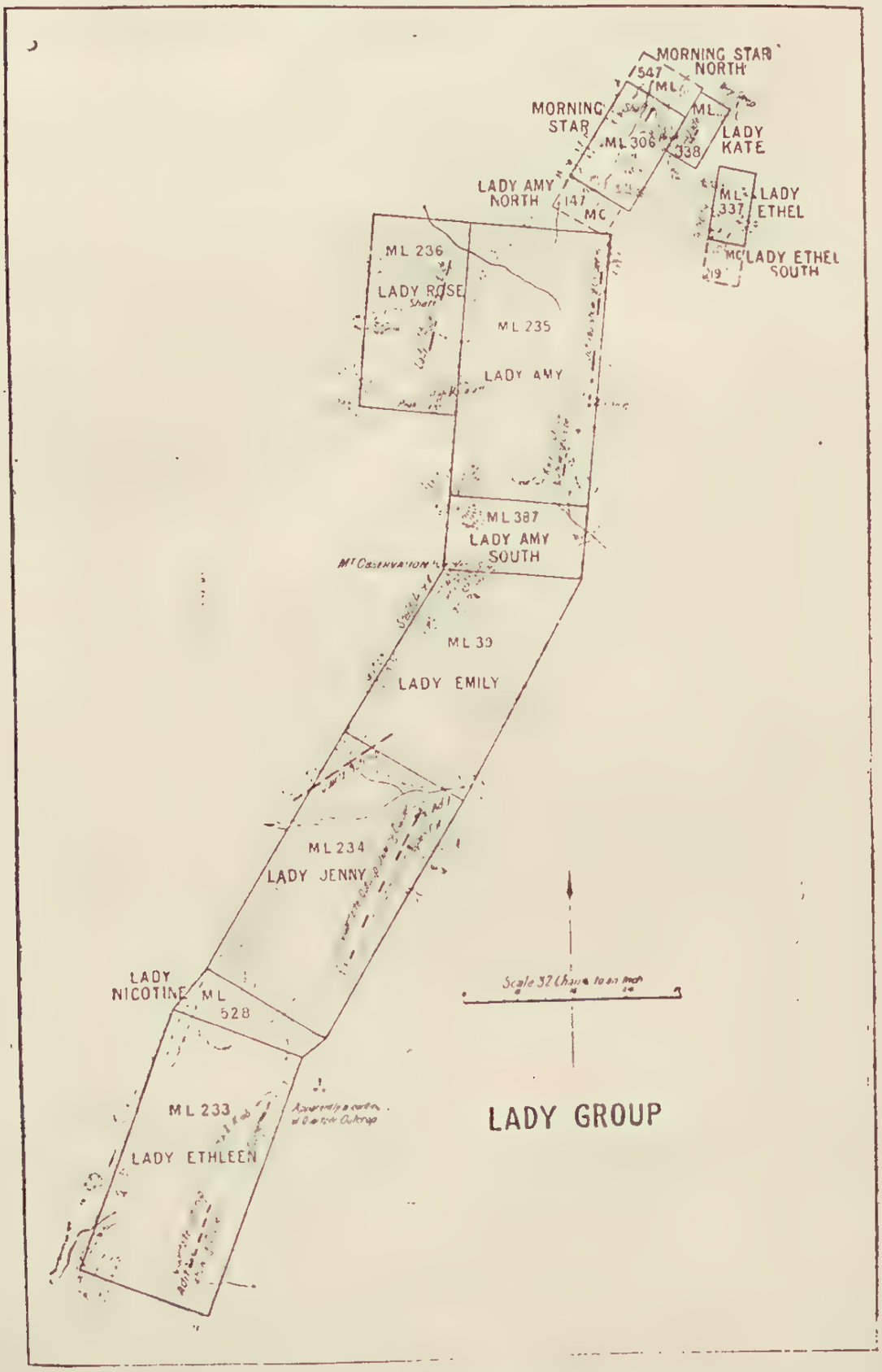
A formation, 20 ft. wide, at the cut, "Can be traced for a considerable distance." "A large outcrop of medium grade on the same line of outcrop as the Springs."

LADY GROUP.

The Lady Group, which includes the Ralston Leases and a few others, comprises the Lady Ethleen, Lady Nicotine, Lady Jenny, Lady Emily, Lady Amy South, Lady Amy, Lady Amy North, Morning Star,

* Presumably glance is meant.

Morning Star North, Lady Rose, Lady Ethel South, Lady Ethel, and Lady Kate. Of these only the first, third, seventh, eighth, ninth, and eleventh were being worked.



The group extends along a precipitous range on the western side of Jimmy's Springs Creek, 38 miles west-south-west of Cloncurry and 5 miles south-west of the Springs Camp.

Lady Ethleen (M.L. 233).

Mgr., Moore.

Location, Etc.

The Lady Ethleen is the southernmost of the Lady Group, and is 3 miles south-west of the Springs Camp.

Its area is 80 ac. The lease is held under option by the Queensland Exploration Company.

Development.

An adit, in the eastern part of the lease, was 100 ft. in length*, when inspected, the approach being 24 ft. long.

Ore-body.

The main outcrop is on a ridge over 100 ft. above the level of the adit, which is being put in in a north-north-easterly direction, but is as yet in indurated slates with ironstains on cracks. The whole cap of the ridge, over a width of a chain, is iron-stained and silicified, the cupriferous gossany part being only 20 ft. wide and the copper content not more than 1%. Copper ore does not appear on the surface within 4 ch. of the adit mouth. There is nothing to indicate that rich ore except in bunches or thin veins will be found on the adit level.†

Lady Nicotine (M.L. 528).

Mgr., Moore.

Location, Etc.

The Lady Nicotine adjoins the Lady Ethleen on the north.

Its area is 8½ ac. It is held under option by the Queensland Exploration Company.

Ore-bodies.

The lease is on the Lady Jenny-Lady Ethleen line, but nothing has been done to prove it here.

Lady Jenny (M.L. 234).

Mgr., Moore.

Location, Etc.

The Lady Jenny adjoins the Lady Nicotine on the north.

Its area is 80 ac. The property was being tested under option in November last by the Queensland Exploration Company.

Development.

An opencut, near the centre of the eastern side of the lease, is 100 ft. in length, and its average depth at right angles to the surface is 7 ft.

---

* At the end of December, 1906, the underground manager (Mr. McLeod) reported it to be 175 ft. in length.

† The underground manager informed me in December last that small and irregular but rich veins of ore had been met over a width of 12 ft.

An adit in the north-eastern part of the lease has an approach 20 ft. long, and is itself 155 ft. in length.* For two-thirds of its length it runs south-south-west, the inner third bending round to south-west-by-south.

A pothole sunk 1¼ ch. south of the adit has been filled in again.

Ore-bodies.

A large outcrop of quartz runs north 30° east (dipping steeply north-north-westwards) along the eastern side of the lease, and several gossany outcrops have been found in the country adjacent to it on the east.

The long trench on the range top was opened to test this ground, the outcrop comprising quartzites and schists, the latter where crushed carrying malachite. The exposure, however, is very disappointing—decomposed schist, quartzite and altered porphyry (?), in places rather thin-bedded. There are thin veins of gossan and occasional lumps of limonite and chrysocolla, the richest not containing more than 1% copper, while the average of the whole length of the trench would not be above a trace.

The pothole south of the adit is in green-stained country rock, with much quartz. The ore is somewhat gossany, and is promising in appearance, but none of that now visible carries more than 15% copper.

The main crop pinches out 2 ch. south-south-west of the mouth of the adit. It is 50 ft. in greatest width, and consists of crushed schist and shattered quartz with limonite and malachite, the copper content in the richest parts being 10%.

The mouth of the adit lies between a gossany schist on the east and a big quartzite crop on the west, the adit itself being in quartz-veined chloritic schist striking obliquely across it to the south-south-east. One body of gossan, 10 ft. across, was met 5 ft. within the adit, and stains and bunches of carbonates appear 40 ft. from the mouth continuing for 20 ft. The ground is then barren quartzose slaty schist to near the face, where there is 5 ft. width of quartz and schist carrying gossan and stained by carbonates to the extent of 3% copper. The exposures are most unpromising, but, if any further work is done, it should be in following or sinking on the gossans instead of cutting across them.

There is no sign of fissuring here, the ore-bearing zones being impregnations of crushed country.

There is 1 ton of ore at grass—schist stained by chrysocolla and containing central nuclei of chalcopyrite enriched by chalcocite.

---

* In December it had reached a total length of 210 ft., but was still in barren quartzite.

The outcrops are not worthy of any further attention. The ores on the surface are poor, and likely to be poorer below, as shown in the adit. If, however, any more work is to be done here in search of even medium grade ore, it should be in following the gossans. The wide outcrop on the surface south of the adit is similar in character to the Tharsis (Duck Creek), and considerable quantities of low-grade ore are therefore to be expected here.

Lady Emily (M.L. 391).

Mgr., Moore.

LOCATION, ETC.

The Lady Emily adjoins the Lady Jenny on the north.

Its area is 60 ac. It is held under option by the Queensland Exploration Company.

ORE-BODIES.

Nothing has been done to prove the ore-bodies on this lease, though the Lady Jenny crop and another enter it.

Lady Amy South (M.L. 387.)

Mgr., Williams.

LOCATION, ETC.

This lease lies between the Lady Emily and the Lady Amy.

Its area is 20 ac.

No prospecting has yet been done on this lease.

Lady Amy (M.L. 235).

Mgr., Moore.

LOCATION, ETC.

The Lady Amy adjoins the Lady Amy South on the north.

Its area is 80 ac. It is under option to the Queensland Exploration Company.

DEVELOPMENT.

One cut, 30 ft. in length, was opened about two years ago on the ridge top in the north-eastern corner, and there are two potholes on the southern boundary near the south-eastern corner peg.

ORE-BODIES.

The country here is highly altered slate striking north 15° west, any variation from vertical being to the westwards. Small isolated bunches of copper ore, of a few tons weight, occur in these slates, two

of which have been exposed in the southern potholes, where there is 18 in. to 2 ft. width of cupriferous gossan dipping 3 in 1 to the north. About 5 tons of ore has been shipped from here.

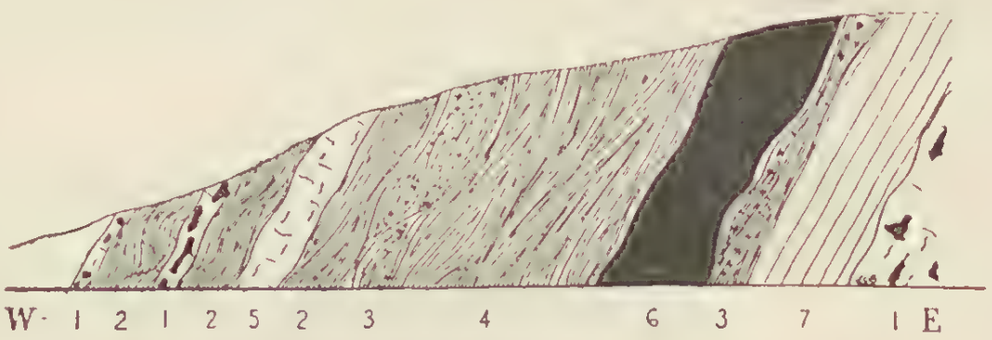


FIG. 21.—SECTION IN CUT LADY AMY.

Scale: 4 ft. to an inch.

1. *Quartz and gossan*
2. *Schist*
3. *Ferruginous schist*
4. *Schist with ferruginous partings*
5. *Iron-stained quartz*
6. *Cellular gossan*
7. *Slate.*

The big cut is in a green-stained and gossany crop, 30 ft. wide and consisting of alternate bands, dipping 60° to the west-north-west, of schist and quartz more or less iron-stained and resembling the Tharsis crush-zone. (See Fig. 21.) This can be followed down the hillside for 5 ch. to the south-west and up the hillside for 1 ch. to the north-east. The most promising part of the exposure is at the eastern end of the cut, where there is 3 ft. width of quartz and gossan separated from a 3 ft. band of cellular gossan by 18 in. ferruginous schist and 3 ft. slate. The cellular gossan should be sunk on, as it is likely to carry copper beneath the surface.

Lady Amy North (M.C. 147).

Mgr., Chaplain.

LOCATION, ETC.

This adjoins the Lady Amy on the north.

Its area is 600 ft. × 350 ft.

Two cuts are being opened 4 ch. apart.

OUTPUT.

Nov., 1905 ... 9 tons ore shipped.

ORE-BODY.

The southern cut exposes 9 in. cupriferous gossan dipping westwards.

In the southern cut a gossany formation, 3 ft. wide, can be seen in schistose slate. It is said that between 8 and 9 tons of rubble,

carrying 35% copper, were obtained here, and have been shipped. There is now paddocked 1 ton of firsts and 1 ton of seconds carrying 15% copper.

Morning Star (M.L. 306).

Mgr., Chaplain.

Location, Etc.

The Morning Star adjoins the Lady Amy North on the north. Its area is 16 ac.

Development.

The main shaft, 15 ft. deep, is near the northern end of the lease. A second shaft, also 15 ft. deep, lies 20 ft. to the east, and a third $2\frac{1}{2}$ ch. to the west, while a fourth, 15 ft. deep, lies 7 ch. to the south of the main shaft.

Output.

1906	...	$14\frac{10}{20}$	tons	shipped	(Chaplin and Connlisk—source doubtful).
		$14\frac{15}{20}$	,,	,,	(Chaplin) ,, ,,
		12	,,	,,	(Chaplin and Glendenning—source doubtful).
		$1\frac{10}{20}$	,,	,,	(Chaplin, Smith, and Connlisk—source doubtful).
		$4\frac{10}{20}$	,,	,,	(Chaplin and party—source doubtful).
		$47\frac{5}{20}$*			

Ore-bodies.

At the main shaft there is a gossany formation, 15 in. wide at the surface and 3 ft. 3 in. wide in the bottom, containing much azurite, as well as malachite, tile ore, and chalcopyrite enriched by chalcocite. The formation is in schist with lenticular quartz veins, and it strikes north 10° east, dipping 3 in 1 to the westward. About 20 tons of 35% ore are stated to have been shipped from this shaft, and there are 12 tons now at grass.

The eastern shaft is on a 4 in. seam of ore lying parallel to that in the main shaft. A bunch of ore found here contained 2 tons, yielding 40% copper.

The western shaft is in country, stained with iron oxides and copper carbonate, and is probably adjacent to a bedding plane striking north-north-east. It is on the line of strike of the ore-body seen in the Lady Amy. Some 4 tons of limonite-chalcocite (glance) ore, carrying 25% copper, have been shipped from here.

The southern shaft is in a formation 3 ft. wide and carrying up to 10% copper and little or no quartz, just to the west of a quartz and gossan blow. Practically all the material raised from the shaft is cupriferous, and, though no ore has been bagged from here, 3 tons, containing 20% copper, have been paddocked. Sinking should be continued here, and a crosscut opened eastwards.

* At the end of 1906, Mr. Chaplain stated that 25 tons of 35% ore had been shipped, and there were then at grass 20 tons of ore, carrying between 20 and 35% copper.

Morning Star North (M.L. 547).

Mgr., Chaplain.

LOCATION, ETC.

This adjoins the Morning Star on the north.

Its area is 5 ac.

Two potholes have been dug on this lease, 3 ch. north, and 6 ch. north-east of the Morning Star northern shaft.

ORE-BODY.

Large outcrops of copper-stained quartzite on this lease strike south 5° east. At the north-eastern hole there is 2 ft. 6 in. width of formation, 5 ft. of schist, and 18 in. of gossan, quartz, and copper ore—a not very promising exposure.

Lady Kate (M.L. 338).

Mgr., Chaplain.

LOCATION, ETC.

The Lady Kate adjoins the Morning Star on the north-east.

Its area is 5 ac.

OUTPUT.

1905 ... 7 tons raised.

ORE-BODY.

In this lease there is a big crop of reddish quartzite on the joints of which a few small bunches of ore have been found with quartz.

Lady Ethel (M.L. 337).

Mgr., Chaplain.

LOCATION, ETC.

The Lady Ethel lies 10 ch. to the east of the Morning Star.

Its area is 6 ac.

There is one shaft, 10 ft. deep.

OUTPUT.

Total ... 6 tons shipped.

ORE-BODIES.

The country here is slate, striking north-by-west and dipping steeply west-by-south. Bunches of copper ore occur on joints and along the bedding planes, and in the latter case are sometimes connected by thin gossan leaders, even though ½ ch. apart.

The shaft was begun on a 2 in. leader of cupriferous gossan striking east and west. This leader is in a joint, and it opens out to 2 ft. width, where it crosses a ferruginous belt of slate. However, in all only 6 tons of ore were obtained here.

Lady Ethel South (M.L. 219).

Mgr., Chaplain.

Location, Etc.

This adjoins the Lady Ethel on the south.

Its area is 400 ft. × 350 ft.

Output.

Total ... 14 tons shipped, carrying 35% copper* (*vide* Mr. Chaplain).

Lady Rose (M.L. 236).

Mgr., Moore.

Location, Etc.

The Lady Rose adjoins the Lady Amy on the west.

Its area is 40 ac. The property when visited was under option to the Queensland Exploration Company.

Development.

The only work done has been the sinking near the centre of the lease of a shaft 91 ft., where water was met.

Ore-bodies.

The shaft is in country on the western side of a blow of quartz striking north 30° east and dipping 8 in 1 to the north-west. The blow is 4 ch. in length, 20 ft. in width, and stands 35 ft. out of the ground. It is slightly stained by malachite in parts, carries occasional bunches of gossan, and one or two patches of copper ore including cuprite were noticed on the western side, where also "copper weed" is growing. The indications, however, do not justify any further work here. The shaft at the time of my visit had just reached quartzite carrying crystals of pyrite.†

Ferruginous and copper-stained quartz crops 2 ch. to the south-west of the big blow, but is scarcely worth any further attention.

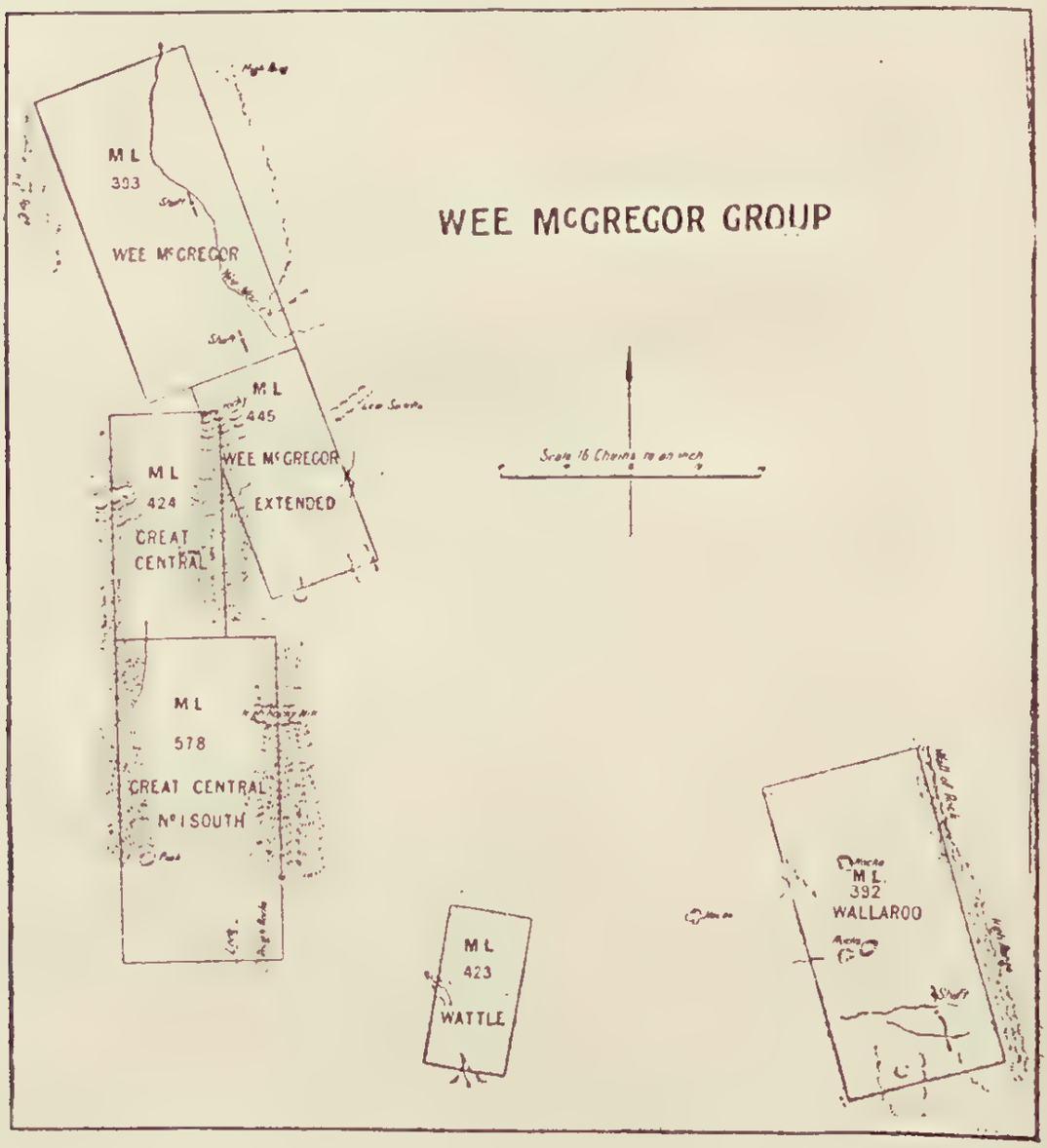
WEE MACGREGOR GROUP.

The Wee MacGregor Group lies less than a mile west of the Lady Group, from which it is separated by a practically inaccessible range. The leases lie some of them within the catchment area of Jimmy's Spring Creek and some within that of Cattle Creek, both of which are tributaries of the Corella. The former are connected with the Springs Camp by a fairly good dray road, but all stores for the latter have to be packed over the divide.

* This is reported to have comprised only surface boulders from various parts of the lease.

† Mr. McLeod, the underground manager, informed me in December that at 100 feet from the surface only barren quartz was exposed.

The country rocks comprise schists, quartzites, and an altered felspathoidal rock that may be porphyry.



The Great Central No. 1 North and No. 1 South and the Lord Nelson are included in this group, but work has not yet commenced on them.

Wallaroo (M.L. 392).

Location, Etc.

The Wallaroo lies 4 miles south-west of Springs Camp.

Its area is 20 ac. The ground is held by the Wee MacGregor Cloncurry Mines, Ltd.

Literature.

For title of report, numbered as below, see Introduction.

(12) Mr. Waller reported:—

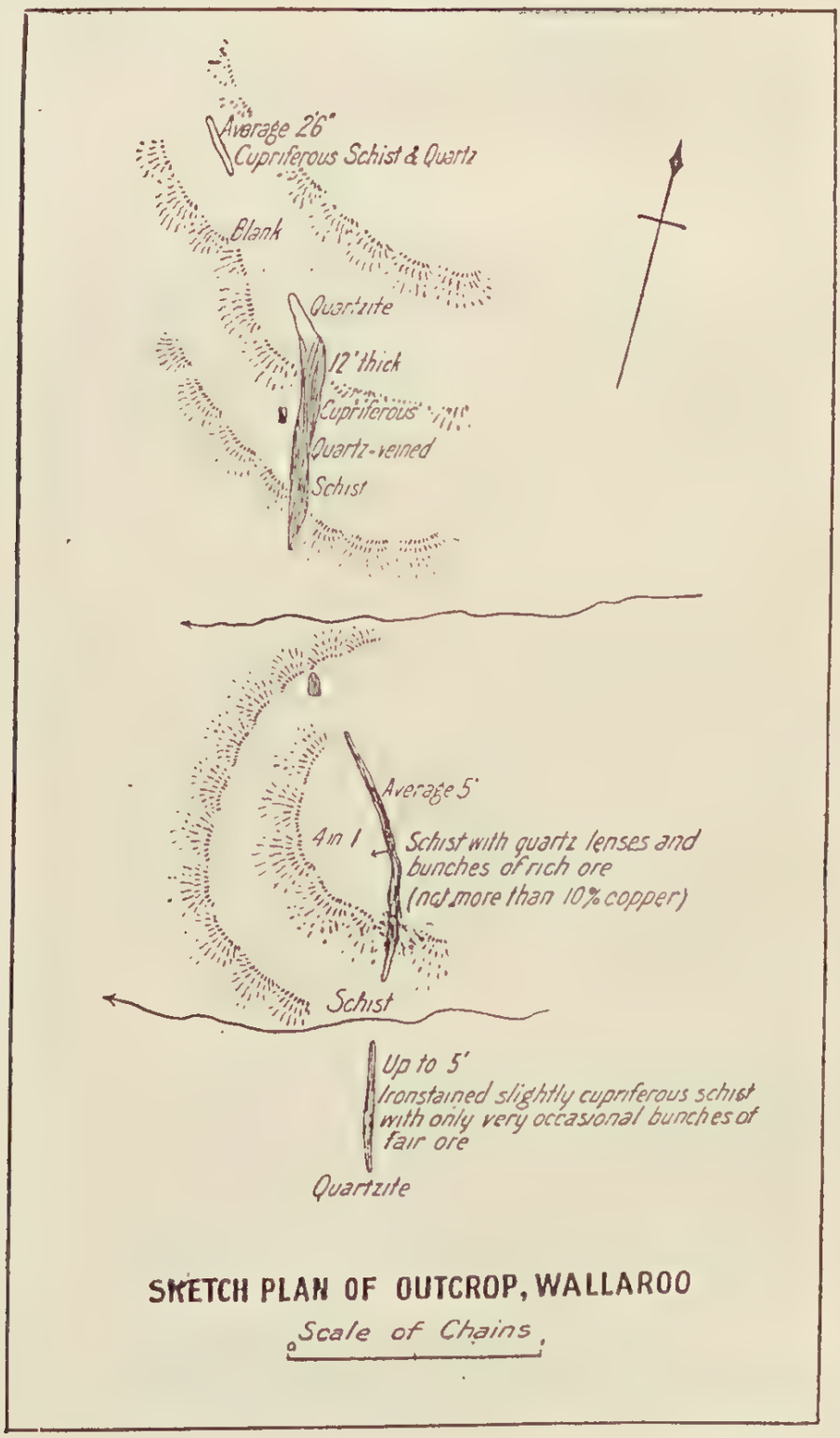
The lode is traceable for 1,000 ft, and carries more or less copper almost the whole way. There are two principal outcrops of ore. One of these is 110 ft. long by 6 or 8 ft. in width. The ore occurs here in veins and bunches in a siliceous lode. A sample taken from this outcrop, omitting quartz, returned 31·6 per cent. The other outcrop of ore consists of a lens of gossan 70 ft. long by 15 ft. wide. A surface sample from this returned 20 per cent. copper.

Development.

Work had only just begun in December last, one shaft having been sunk 17 ft. This is located 5 ch. from the southern boundary and 3 ch. from the eastern.

Ore-bodies.

The ore-bodies here occur in five separate outcrops, extending over a total distance of $8\frac{1}{2}$ ch. in a general north-by-west direction, the difference in elevation of the crops on the ridges and those in the gullies being 50 ft.



Over one half of the main crop is quartz, occurring as parallel lenticular veins, and one quarter is schist, the copper ore (malachite and limonite) occurring chiefly in the former where crushed, as on the Chinaman freehold and others at Duck Creek.

Iron-stained quartzite lies to the east of this outcrop, and reddish quartzites to the west of the shaft. The main crop strikes north-north-east dipping 3 in 1 to the west-north-west. Near the centre of the crop it is cupriferous over a width of 10 ft., and my sample contains cellular and clayey quartz-bearing gossan and dense limonite impregnated with malachite and chalcocite; chloritic schist veined with quartz and stained by malachite; and granular iron-stained quartz. It carries (Government Analyst):

Copper	...	=	13·2%
Gold	...	=	5 dwt. per ton.
Silver	...	=	6 ,, ,,

The shaft is being sunk in schist 6 ft. to the west of this spot, and at the time of my visit had just struck bunches of ore, of which 1 cwt., estimated to carry 30% copper, had been raised—fine grained malachite and azurite with tile ore. Further sinking is warranted, as there is likely to be here large quantities of low grade siliceous sulphides below water level.*

The copper ore fails within 1 ch. to the south, but the quartz, which continues a little further in the schists, is still ferruginous. Northwards the crop increases to 12 ft. in width, and is rather more gossany, but after about 10 ft. it becomes siliceous and the end of the shoot may be taken as at 30 ft. from the shaft, though the quartzite is ferruginous for a further 20 ft. to the north-north-west.

The northern crop, similar in constitution to that at the main shaft, is 1 ch. beyond the northern end of the latter crop. It is 30 ft. in length, and averages 2 ft. 6 in. in thickness.

At 1 ch. south of the main crop there is a small cupriferous outcrop, and 20 ft. beyond it, to the south-south-east, is the boomerang crop, which is 2 ch. in length and averages 5 ft. in width, its peculiar shape being due to its dip and the contour of the ground. It consists of schist with quartz lenses and bunches of fairly rich ore—the latter carrying up to 10% copper.

* A correspondent states in the "British Australasian" of 4th July, 1907, that in the crosscut from the main shaft at the 85 ft. level sulphides carrying 10 % copper had been proved over a width of 30 ft. Further it is mentioned that sulphides were being entered by the drive from No. 2 shaft (located 300 ft. south of the above).

The southernmost crop, ½ ch. to the south-west of the last, is 5 ft. in greatest thickness. It is composed of iron-stained, but only slightly cupriferous, schist and quartz, with only occasional bunches of fair grade ore. Beyond it to the south pinkish quartzite appears.

Wattle (M.L. 423).

Location, Etc.

The Wattle lies 16 ch. west of the Wallaroo.

Its area is 5 ac. The ground is held by the Wee MacGregor Cloncurry Mines, Ltd.

Work had not begun here at the time of my visit to the group, and my time being short, it was therefore not inspected.

Literature.

For title of report, numbered as below, see Introduction.

(12) Mr. Waller has written:—

The lode strikes 20° East of North, and dips to the West. It outcrops for a distance of 200 feet, showing Copper ore in several places. The principal outcrop of Copper ore is situated towards the south end of the lode, and consists of gossan and quartz carrying carbonate and oxide of copper, and a little glanz and yellow Copper. This outcrop is 20 feet long by 6 feet wide. A surface sample taken from here returned 19 per cent. Copper.

Great Central (M.L. 424).

Location, Etc.

The Great Central is located south of the Wee MacGregor.

Its area is 10 ac. The lease is held by the Wee MacGregor Cloncurry Mines, Ltd.

Literature.

For title of report, numbered as below, see Introduction.

(12) Mr. Waller's report is as follows:—

The lode is a very large one, about 100 feet in width, and composed at surface of gossan and quartz. . . . The western or hanging-wall portion of the lode appears to be mainly quartz, while the eastern or footwall portion is gossan. The gossan extends along the surface for 400 feet, containing more or less Copper the whole way, but the main shoot of ore is approximately in the centre. The gossan at this place is 70 feet wide, and appears to carry good Copper for the whole of this distance. Practically every stone broken carries good Copper, and most of it is of good grade. A rough sample taken right across the 70 feet, omitting only one or two small lenses of quartz, gave a return of 17 per cent. Copper. This good ore appears to extend along the lode for about 120 ft., though probably it does not maintain its full width of 70 feet for the whole of this distance. At any rate, the surface indications point to the presence of a large and rich ore-body in this lode, which deserves to be energetically opened up. . . .

Development.

Work had not long commenced when this lease was visited in December last, there being then only an adit 17 ft. in length with an approach 30 ft. long. This is 1 ch. from the eastern boundary and 6 ch. from the southern.

Ore-bodies.

A belt of schist, running nearly north and south and dipping 10 in 1 to the west, has here been found to be cupriferous over a limited area. This belt, which lies between two bands of quartzite, is 150 ft. in greatest width, and shows signs of great crushing. Lenticular quartz veins have been developed, and the intervening schists are very ferruginous, and in addition they are stained by malachite over the whole width. Southwards of the thickest part the copper ores are somewhat more concentrated, there being crops, 6 ft. wide and 30 ft. long, that will probably yield 10% copper, and give promise of being richer below.

Beyond a chain to the south, however, the iron and copper contents may be considered negligible quantities, and the place of the schist is taken by barren white quartzite. Northwards of the thickest part of the area the amount of copper in the schists decreases, and, at a chain distant malachite is found instead staining ferruginous cellular quartz on the line of the strike of the western quartzite band, which passes 1 ch. to the west of the mouth of the adit. The schists are quite barren at the mouth of the adit, which is being opened to prove the cupriferous country at a depth of 85 ft. below the crop, and is 2½ ch. to the north of the thickest portion. This work is warranted by the appearance of the hitherto untouched outcrop, from which it is to be anticipated that richer bunches, up to a chain in length and perhaps 10 ft. wide will be found, separated, however, by much barren country.

The cross vein mentioned under the description of the Wee MacGregor Extended passes about 5 ch. north of the adit, but was not noticed to extend further westwards. There is possibility of its being on a line of fault, and that the Great Central cupriferous zone is the southern part of the Wee MacGregor zone, which would necessitate a heave of nearly ¼ mile.

Wee MacGregor (M.L. 393).

Location, Etc.

The Wee MacGregor lies on a branch of Cattle Creek, ½ mile north-west of the Wallaroo.

Its area is 20 ac. The lease is the property of the Wee MacGregor Cloncurry Mines, Ltd.

Literature.

For title of report, numbered as below, see Introduction.

(12) Mr. Waller writes:

This is a large lode, out-cropping at the surface for a distance of 1,000 feet. . . . The width of the lode varies from 6 feet to 15 feet, and may be even wider in places. The outcrop is composed of moderately soft but somewhat siliceous gossan, carrying more or less Copper in the form of carbonates and oxides, associated with occasional lenses of quartz. Of the 1,000 feet of outcrop, approximately one-half, or 500 ft., carries apparently good Copper. No work has yet been done on the lode, so it is at present only possible to speak of surface indications. These are of a highly promising character. A sample from the outcrop at the North end, taken by chipping here and there along the outcrop, returned 20 per cent. copper. At the South End the width of ore of this grade is at least 15 feet. A few very rich boulders of red oxide of Copper are to be seen at the surface at this point, assaying up to 80 per cent. Copper.

Development.

Work was in the initial stages at the time of my visit in December. One shaft, near the centre and 2 ch. from the eastern boundary, was only 15 ft. deep; and the other, 2 ch. from the southern boundary, was 20 ft. deep.

Ore-bodies.

The northern outcrop comprises crushed schist, veined with quartz over a width of 12 ft., and a length of about 1 ch. Stains of malachite are to be seen, but do not appear to extend below the surface. The crop is somewhat gossany, and this is the most promising feature about it. No trenching has been done, but the shaft is being sunk on the western side, the first 15 ft. of sinking having been in ferruginous decomposed slate, with slight stains of copper and occasional bunches of ore, rather more abundant and richer near the surface than in the lower part. A second crop, 1 ch. in length, occurs 1 ch. to the south-south-east on the line of strike of the above.

The southern crop extends from the shaft for 40 ft. to the north and 30 ft. to the south, the greatest width (8 ft.) being just south of the shaft, although malachite stains were noticed in the country over much greater widths. It is made up of crushed schist with veins of quartz and slight impregnations of malachite. The richer portions, which may be 2 ft. in thickness and which each contain a few tons, are expected to run 20% copper, but the crop as a whole will not yield more than 5%. The shaft is on the western (hanging-wall) side, and to 20 ft. depth, where much quartz was appearing, is in kaolinised country with copper stains, impregnations, and bunches. These bunches not infrequently have a kernel of cuprite or of cuprite and

limonite surrounded by laminated malachite, the outer parts of which contain much clayey impurity. (See Fig. 22.) About 1 ton of ore has

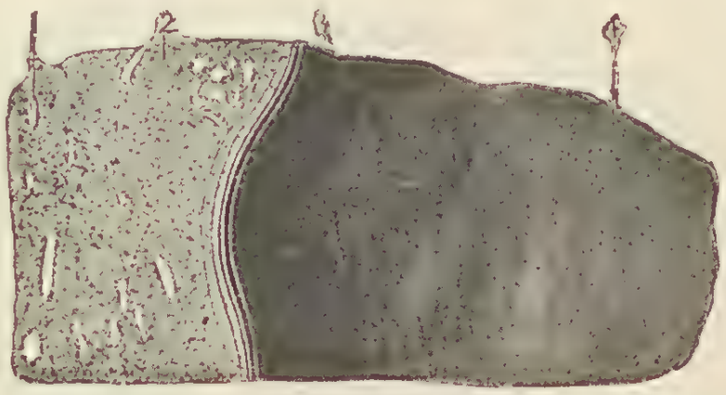


FIG. 22 (NATURAL SIZE).—OXIDISED ORE, WEE MACGREGOR.

1. Kaolin
2. Earthy malachite
3. Limonite
4. Cuprite (ferruginous towards the limonite).

been paddocked and this consists of one-third ferruginous cuprite, one-third malachite, and one-third clayey impurity, the whole stained by earthy malachite and azurite and averaging perhaps 40% copper. The material from the shaft should yield at least 2% copper, earthy malachite occurring in the kaolin.

Wee MacGregor Extended (M.L. 445).

LOCATION, ETC.

This adjoins the Wee MacGregor on the south-south-east.

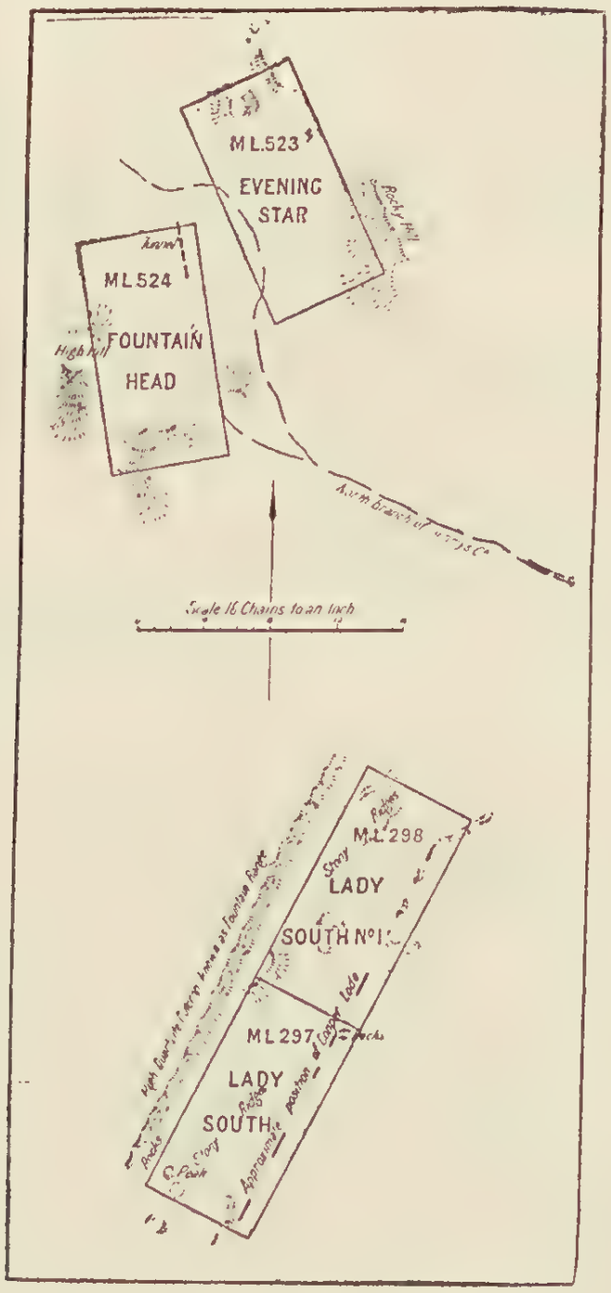
Its area is 8 ac.

ORE-BODIES.

The Wee MacGregor formation can be traced southwards into this lease, being here a ferruginous quartzite destitute of copper. An unusual occurrence here is that of a cross vein, which makes a prominent crop, dipping steeply northwards, for over $\frac{1}{4}$ mile to the east of the formation. It is several feet in width, and, viewed from a distance, has a roughly banded structure, but closer inspection shows it to be composed of a network of veinlets of quartz in silicified slate. Much of the quartz has a chalcedonic texture, much is cellular, and a little has the "dogtooth" structure (sometimes in radiating rosettes).

LADY SOUTH GROUP.

The group includes, besides those mentioned below, the Lady South No. 1, the Evening Star, and the Hæmatite.



Lady South (M.L. 297).

Mgr., Donner.

LOCATION, ETC.

The Lady South lies just east of the Fountain Range, 1½ mile south-south-west of the Lady Ethleen and 10 miles south-west of the Springs Camp.

Its area is 10 ac.

ORE-BODY.

The surveyor's plan shows the outcrop to run north-north-east.

o

Fountain Head (M.L. 524).

Mgr., McCormack.

LOCATION, ETC.

The Fountain Head is on Jimmy's Spring Creek, 1¼ mile south-by-east of the Wallaroo.

Its area is 10 ac.

A tunnel has been opened in the north-eastern corner of the lease.

ORE-BODY.

An outcrop, striking north-by-west, is shown on the surveyor's plan.

MELBA GROUP.

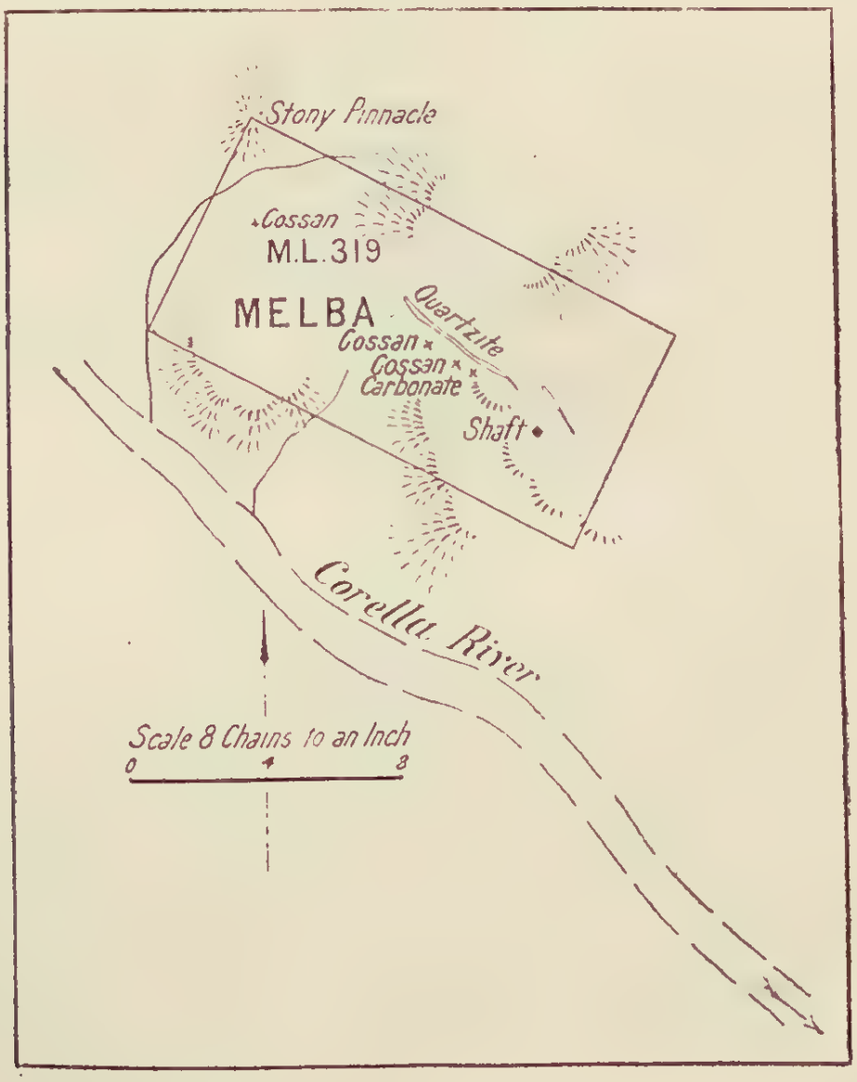
The group consists of only the Melba and the Rising Sun, the latter of which was not visited.

Melba (M.L. 319).

Mgr., Matheson.

LOCATION, ETC.

The Melba is situated on the western bank of the Corella River, 6½ miles west-by-north of the Springs Camp. The distance by the



dray track down the river to the Rosebud is twice the above. It is 3½ miles west-south-west of the Mona.

Its area is 10 ac. The lease is held by the Willcocks Cloncurry Development Syndicate.

Development.

A shaft has been sunk to a depth of 50 ft., and from it drifts have been opened 12 ft. north-west and 15 ft. south-east, and crosscuts 10 ft. north-east and 12 ft. south-west. This is in the south-eastern corner of the lease. One or two shallow holes have been made in the vicinity of the shaft, and there are two trenches near the centre of the lease.

Output.

1906 ... 60 tons shipped, carrying 25% copper (manager's report)
15 ,, seconds at grass.

Ore-bodies.

There is little on the surface to indicate the existence of any quantity of rich ore here. A formation (that met in the eastern drive) is to be seen in a pothole 20 ft. north-east of the shaft. Ill-defined bunches of carbonate-bearing ore were noticed 2½ ch. north-west of the shaft, and gossan at 3, 4, and 10 ch. distant from the same. The trenches near the centre of the lease offer disappointing exposures and are apparently on separate lenses.

Most of the ore, which occurs in lenticular bunches, seems to have come from the upper part of the shaft. The ore-bearing seam passes out of the shaft to the east at 20 ft. from the surface, but comes in again at the shaft bottom.

In the north-western drive stringers and small lenses of slightly decomposed pyrite were noticed in schist, between two vertical partings 2 ft. apart. The south-eastern drive is in chloritic schist with some sintery lime towards the end. At the end of the south-western crosscut there is a formation of schist, 2 ft. 6 in. wide, partly replaced by chalcopyrite, now in process of alteration into limonite. It is ill-defined and not to be expected to last, even though the footwall country is somewhat slickensided internally. The north-eastern crosscut is in a loose granular siliceous formation having some resemblance to fault ground. Scattered through it are crystals of actinolite and crystalline country rock, and lumps of glance, with scattered grains of chalcopyrite, are stated to have been found in the more ferruginous portions, as well as nodules of malachite.

Further sinking to test this formation is warranted. The paddock at the shaft has 15 tons of poor seconds (limonite with scattered pyrite). The manager's reports state that 40 tons of 25% ore were obtained from within 14 ft. of the surface, but only 20 tons were obtained from the remainder of the sinking, driving, and cross-cutting.

SECRET GROUP.

Neither the Secret nor the Shakespear, the second lease in this group, was visited, and no particulars of interest being available, the latter is omitted.

Secret (M.L. 264).

Mgr., Matheson.

LOCATION, ETC.

The Secret is in a deep and narrow valley 4 miles west-by-north from the Springs Camp, and 3 miles south-south-east of the Rosebud.

Its area is 10 ac. This is held by the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

Near the southern boundary a shaft was sunk 33 ft., and No. 1 crosscut opened from the bottom (16/9/05). Shaft 50 ft. deep (5/10/05) and No. 1 crosscut 27 ft. in; No. 2 crosscut, at 50 ft., in 12 ft. Shaft 95 ft. (21/5/06) and No. 3 crosscut 19 ft. in.

ORE-BODIES.

A formation, 22 ft. wide and carrying 11% copper, is reported* to have been met in No. 1 crosscut, and No. 2 crosscut proved 24 ft. of ore assaying 10·5% copper.† The last 7 ft. is said to be in cupreous iron pyrite.

ROSEBUD GROUP.

No particulars of the Nick of Time are available, and it has therefore been omitted from this record. None of the leases was inspected.

Rosebud (M.L. 266).

Mgr., Matheson.

LOCATION, ETC.

The Rosebud, on the northern bank of the Corella, is 4½ miles north-west of the Springs Camp. This is one of the leases held by the Willcocks Cloncurry Development Syndicate.

Its area is 10 ac.

DEVELOPMENT.

An adit has been opened 106 ft., and crosscuts opened at intervals of 25 ft. A winze has also been sunk 25 ft. below the adit. Opencuts are shown on the surveyor's plan on the southern boundary and 3 ch. to the north-north-west.

ORE-BODY.

There is an outcrop here, 20 ft. wide and 23 ft. high, striking north-by-west. The lode, alongside which is the adit, has been tested by cross-cutting, with results as follows‡:—No. 1 crosscut—8 ft. ore

* Warden's report for August, 1905. † Warden's report for December, 1905.
‡ Q.G.M.J., 15 Nov., 1905, and 16 Feb., 1906.

assaying 11·1% copper; No. 2 crosscut—15 ft. ore assaying 8%; No. 3 crosscut—20 ft. ore assaying 2·4%; and No. 4 crosscut—siliceous ore assaying 2·5%. These the manager considered unsatisfactory. The lode became very pyritous in the winze, but the copper value continued constant.

Mona (M.L. 520).

Mgr., Woods.

Location, Etc.

The Mona is on the northern side of the Corella River, 4½ miles north-west of the Springs Camp. It is 12 ch. north of the Nick of Time.

Its area is 5 ac.

One shaft has been sunk near the centre of the lease.

Output.

1906 ... 23 tons shipped.

Ore-body.

The surveyor's plan shows the outcrop striking north-north-west.

JUBILEE GROUP.

The Sunflower and Mountaineer have not been included here, as no description has been made of the ore-bodies. The group was not visited.

Jubilee (M.L. 460).

Mgr., Lobston.

Location.

The Jubilee is on Running Creek, 8 miles north of the Springs Camp. It adjoins the Printy, and lies 3 miles north-west of the Imperial.

Area.

Its area is 15 ac. The ground has been under option to Jacomb's Syndicate.

Development.

There are two shafts on this lease—No. 1, 32 ft. deep; and No. 2, 46 ft deep. One of them is near the centre of the eastern side, the other near the middle of the southern.

Ore-body.

The surveyor's plan shows a lode striking north-by-east from the southern to the northern shafts and then north-north-west to the northern boundary. The outcrop is similar to that on the Springs—a formation carrying bunches of ore. The ore at 45 ft. in No. 2 shaft is said to have assayed 34·7%.

OUTPUT.

1904	...	$25\frac{19}{20}$ tons shipped (from Corella P.A.)
1905	...	18 ,, ,, (,, Jubilee and Printy)
	Total	$43\frac{19}{20}$,, ,,

Printy (M.L. 255).

LOCATION, ETC.

The Printy adjoins the Jubilee on the north.

Its area is 20 ac.

Some work has been done in the south-eastern corner.

ORE-BODY.

The ore-body worked is believed to be on the line opened in the Jubilee, the general strike of which in this lease is slightly west of north-north-west.

SUNSET GROUP.

Nothing is known of the nature of the May Day and Alice G. ore-bodies, and descriptions of the leases have therefore been excised. The group was not visited.

Sunset (M.L. 267).

Mgr., Campbell.

LOCATION, ETC.

The Sunset is on Green Creek, 10 miles north-by-west from the Springs Camp.

Its area is 20 ac.

The shaft was 30 ft. deep in December, 1906.

OUTPUT.

1906 ... 26 tons at grass (5/3/06).

ORE-BODY.

Some 40% chalcocite ore is said to have been found here, but it is understood that development did not turn out well.

Sunset No. 1 North (M.L. 425).

Mgr., Copley.

LOCATION, ETC.

This adjoins the Sunset.

Its area is 10 ac.

OUTPUT.

1906 ... 6 tons at grass (5/3/06).

Rosewood (M.C. 289).

LOCATION, ETC.

The Rosewood (or Sunset No. 1 South) is on Green Creek, 9½ miles north-by-west of the Springs Camp, and adjoins the Sunset on the south-east.

Its area is 10 ac. It is one of the leases held by the Willcocks Cloncurry Development Syndicate.

Lidster (M.L. 348).

Mgr., Entriken.

LOCATION, ETC.

The Lidster is 10 miles north-by-west of the Springs Camp.

Its area is 40 ac.

DEVELOPMENT.

An adit runs 10 ft. into the lode formation (5/3/06), in about the centre of the lease. This was put in by Jacomb's Chillagoe Syndicate.

ORE-BODIES.

Mr. Warden Cherry reported—"A very large copper-stained formation, with occasional patches of gossan and seams of ore." (5/4/06.)

Rose (M.L. 332).

Mgr., Allis.

LOCATION, ETC.

The Rose lies 10½ miles north of the Springs Camp.

Its area is 5 ac. It is held under option by the West Cloncurry Copper, Ltd.

Wilmot's Valley (M.L. 374).

Mgr., Wilmot.

LOCATION, ETC.

Wilmot's Valley lies 11½ miles north-by-west of the Springs Camp. It is a mile and a half north of the Sunset.

Its area is 10 ac.

DEVELOPMENT.

A shaft was 27 ft. deep, and driving was going on in December last.

OUTPUT.

1906	...	10 tons shipped (reported).

ORE-BODIES.

The shaft is on the middle of three parallel outcrops, striking within a few degrees of north. There is reported to be a fair amount of 22% ore here, which it does not pay to ship.

ENQUIRY GROUP.

The King's Crown belongs to this group, but has been omitted on account of no particulars being available. The mines were not visited.

Enquiry (M.L. 265).

Location, Etc.

The Enquiry lies on Green's Creek 10 miles north-west of the Springs Camp.

Its area is 5 ac. This is one of the Willcock's Cloncurry Development Syndicate's leases.

One small cut has been opened.

Output.

1906 ... 5 tons of fairly good ore at grass.

Ore-body.

The manager has stated that the Enquiry is of little importance. The cut exposes 3 to 4 ft. of copper-bearing formation, according to Mr. Cherry.

Snowstorm (M.L. 317).

Location, Etc.

The Snowstorm is on Charley's Creek 12½ miles north-west of the Springs Camp.

Its area is 5 ac. The lease is under option to the West Cloncurry Copper, Limited, but has not been worked.

Ore-body.

The Snowstorm crop is reported to be a siliceous body of great width.

Feathertop (M.L. 316).

Mgr., Allis.

Location.

The Feathertop is located on a tributary of the eastern branch of the Leichhardt River, 13½ miles north-west-by-north from the Springs Camp.

Area.

Its area is 5 ac. The lease is under option to the West Cloncurry Copper Company.

Ore-body.

There is reported to be a big siliceous body here.

King's Cross (M.L. 426).

Mgr., Carty.

Location, Etc.

The King's Cross is located 11½ miles north-by-west from the Springs Camp.

Its area is 20 ac.

The shaft was reported to be 15 ft. deep in December, 1906.

Ore-bodies.

The ore is said to be of medium grade quartz and gossan. The shaft exposes over 4 ft. of lode apparently increasing in width. Warden Cherry states the country is granite (5/4/06).

MOUNT LIDSTER GROUP.

Little is known of any of the leases of this group.

Mount Lidster (M.L. 339).

Mgr., Entriken.

Location, Etc.

The Mount Lidster lies 14½ miles north of the Springs Camp. It is 1 mile north-east-by-north from the Hidden Treasure.

Its area is 80 ac.

Development.

There are two shafts here, 30 ft. and 60 ft. deep respectively (December, 1906), and sunk by Jacomb's Chillagoe Syndicate under option.

Ore-body.

The outcrop is stated to extend north-eastwards over 35 ch. on the lease, but the best ore is exposed at the northern end. One of the shafts is reported to have been sunk in country the other in gossany ore rich in copper.

Hidden Treasure (M.L. 362).

Mgr., Phillips.

Location, Etc.

The Hidden Treasure is 13 miles north-by-west from the Springs Camp. It is 2 miles by track from Mount Lidster.

Its area is 5 ac.

The shaft is 15 ft. deep (Dec., '06). Idle.

Output.

1906 ... 20 tons at grass (5/4/06). Some of good quality.

Ore-bodies.

The Hidden Treasure, May Day, and Mount Lidster are understood to be all on one line.

Faded Rose (M.L. 357).

Mgr., Allis.

Location, Etc.

The Faded Rose is 14 miles north-by-east from the Springs Camp, and adjoins the Roseleaf.

Its area is 10 ac. The lease is under option to the West Cloncurry, Ltd.

Roseleaf (M.L. 328).

Mgr., Allis.

Location, Etc.

The Roseleaf adjoins the Faded Rose on the north-east.

Its area is 10 ac. The lease is under option to the West Cloncurry Copper, Ltd.

The shaft in December, 1906, was said to be 20 ft. deep. Idle.

CHARLEY'S CREEK GROUP.

This is the farthest out group, being really on Leichhardt waters.

Fuchsia (M.L. 326).

Mgr., Allis.

Location, Etc

The Fuchsia is on Charley's Creek, 17 miles north-west-by-north from the Springs Camp.

Its area is 5 ac. The lease is under option to the West Cloncurry Copper Company. It is unworked.

Ore-body.

There is stated to be a large siliceous outcrop on this lease in which a little ore can be seen at intervals.

Copper Cross (M.L. 537).

Mgr., Richards.

Location, Etc.

The Copper Cross is located on Charley's Creek.

Its area is 400 ft. × 350.

Sinking in December, 1906, was reported to be 20 ft. from the surface.

SOLDIER'S CAP.

Soldier's Cap is a typical mesa of Desert Sandstone resting on tilted slates of much greater age. The Cap is situated 17½ miles south-east of Cloncurry. The Mount Wheeler leases are on its eastern flanks, the other mines lying chiefly to the north-east.

MOUNT WHEELER GROUP.

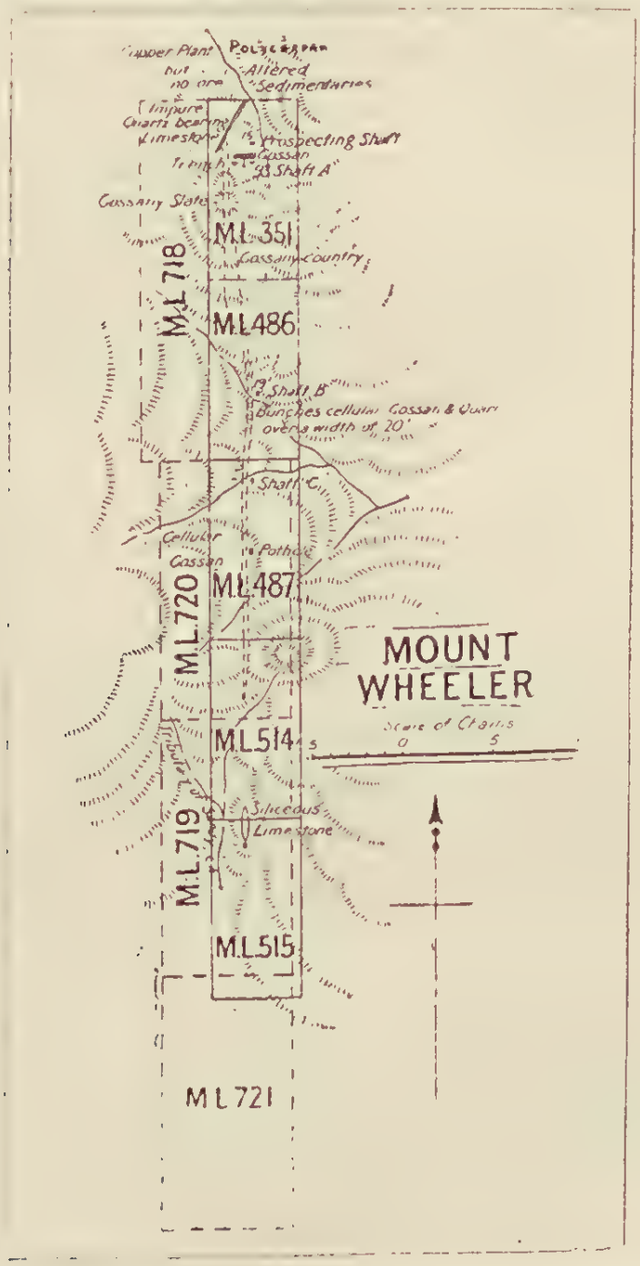
Included here are only those holdings actually seen or concerning which some particulars are available. The following have been omitted:—Forty-second (M.L. 605), Mount Lookout (M.L. 687), Ivy (M.L. 730), Sunrise (M.L. 613), Slate Hill (M.L. 725), and Chalkogen (M.L. 668).

Mount Wheeler (M.L. 351, Etc.).

Mgr., W. Paton.

LOCATION.

The Mount Wheeler leases lie on the eastern slopes of Soldier's Cap, 25½ miles south-east of Cloncurry, the distance by road being



32 miles. The country to the north of Soldier's Cap is beautifully rounded with rolling hills extending out to the rolling downs about 7 miles to the east.

Area.

The surveyed leases are five in number, and each is 5 ac. in extent. They are from north to south: 351, 486, 487, 514, and 515.

Just before my visit application had been made to have the last three cancelled in order that three leases (Nos. 720, 719, and 721), each of 10 ac., might be repegged slightly to the west, but overlapping the old leases. At the same time application was made for a lease of 15 ac. (No. 718) to the west of Nos. 351 and 486. Though Mr. Paton gave cordial assistance, we had considerable difficulty in determining the extent of the old leases and the new ones had not yet been surveyed.

Literature.

For title of report see Introduction.

(12) Mr. Waller says:

> The lode is a very large one; it is composed partly of gossan and ironstone and partly of dolomite and quartz, and occupies a zone of shearing in diorite. . . . It is stained with carbonate of copper at numerous points. The principal outcrop of ore is at the north end, where the zone of shearing is at least 200 ft. wide. The copper is contained in a seam of ironstone 6 ft. thick, crossing this formation almost at right angles. . . . The lode has been broken into in the bottom of this shaft, and carries 10% of copper ore for a width of 5 ft. . .

Development.

The mine was under exemption when visited, and the underground workings were inaccessible.

M.L. 351.—The workings on M.L. 351 comprise one trench and two shafts.

The main shaft (A), in the northern central part of the lease, is 93 ft. in total depth (23 ft. vertical, and then underlying 1 in 1 to the south). At the bottom of the old filled-in part (25 ft. below the top of the underlie) a drive was carried 25 ft. west to intersect the north and south crop.

The prospecting shaft 15 ft. deep is 1 ch. to the north of A shaft.

M.L. 486.—The only opening on this lease is the shaft B, which is in the gully near the centre. It was sunk on an underlie of 1½ in 1 to the east, to a total depth of 80 ft., water level being 47 ft. below the surface. On the 50-ft. level crosscuts run 26½ ft. east and 6 ft. west; and on the 80-ft. level a crosscut runs 19 ft. east.

M.L. 487.—A pothole 3 ft. deep has been opened on the hilltop near the centre of the lease, and the C shaft, 19 ft. deep, is in the gully near the northern boundary.

Geology.

The country here, with the exception of the Desert Sandstone forming the upper part of Soldier's Cap, comprises highly altered sedimentaries, but the occurrence of the pneumatolitic mineral tourmaline* at the Shamrock gold mine, less than 2 miles to the north-north-west, proves that deep-seated igneous intrusion has taken place, this mineral resulting from after actions of the cooling magma.

There is consequently some reason for believing that the accumulations of copper ore may be due in part at least to the consequent activity of ascending solutions.

The leases are strung on a gossan-stained zone traceable in a general north and south direction from near the northern end of M.L. 351 into the middle of M.L. 514. On the continuation of the line a large crop of siliceous limestone crosses the southern boundary of M.L. 514. This, with the general character of the outcrops and the frequent occurrence of limestone in the ferruginous zone to the north, must be taken as evidence simply of the zone being the outcrop of a sedimentary stratum, and the presence of copper-iron ores in it is to be explained by the comparatively easy solubility of the limestone allowing of deposition of those ores even if it had no precipitative action on uprising solutions.

The main gossan crop in M.L. 351 runs out at right angles to the ferruginous zone, and is presumably on a joint or fissure.

Ore-bodies.

M.L. 351.—The ferruginous zone may be taken to commence on the southern side of a north-north-east striking crop of quartzite, north of which no sign of ore other than abundant copper grass (*polycarpæa*) has been found. In this lease the zone consists of gossany slate, and in the southern part is a chain in width.

The trench to the west of shaft A exposes decomposed country, with stains and bunches of ore and gossan. A trial parcel was sent from here by the original prospectors (Pearce and McMorn), but no particulars are available as to its value.

A cross crop of slightly copper-stained gossan runs for over a chain east from the northern end of the zone above referred to, and bulged out to several feet in thickness at the eastern end.

* The tourmaline occurs both in quartz and as masses of acicular crystals in granular and crystallised calcite, in which there are also occasional splashes of chalcopyrite and crystals of pyrite. Scheelite has been reported from here, but my search for the mineral was unsuccessful.

The old vertical part of shaft A went through this lode, while the underlie was sunk above it, but the well at the bottom of the latter proved 6 ft. 6 in. of ore, dipping 1 in 1 to the south. The ore at grass, about 15 tons, is granular limonite, with concentric light and dark blue chrysocolla in cavities, and stains of malachite on cracks. Native copper and gold have also been found in the more gossany parts. The ore runs up to 15% copper.

My rough surface sample from the heap at grass consists chiefly of dense earthy turgite and limonite, in which are occasional cubical casts of gothite after pyrite. Atacamite, malachite, and dioptase in very small quantity are scattered through the limonite, and they are also found as interlacing stringers, $\frac{1}{10}$-in. thick, and have sometimes been deposited in drusy form in cavities, the atacamite in a few cases forming crystalline aggregates, projecting $\frac{1}{8}$-in. from the wall. Mammilated chrysocolla fills most of the openings in the denser limonite, and also stains secondary silica; it varies in colour from very light to sky blue, in the former case being lustreless and very absorbent, in the latter vitreous and non-absorbent. A thin film of secondary silica has been deposited on the walls of open spaces in the more cellular gossan, and hyalite coats the surface of chrysocolla in the larger incompletely filled spaces. The sample contains (Government Analyst):

Copper	10·6%.
Gold	1 dwt. per ton.
Silver	2 dwt. 20 gr. per ton.

The prospecting shaft to the north of shaft A was begun on a formation 6 ft. wide and consisting of altered country with irregular bunches of gossan carrying chrysocolla connected by veins. The formation dipping $\frac{1}{2}$ in 1 to the south-east, the lower part of the shaft shows only iron-stained decomposed slates. There is about 5 tons of gossan with chrysocolla at grass, which will contain say 10%.

M.L. 486.—Passing into M.L. 486 the crop of kaolinised slate becomes siliceous as well as ferruginous, over widths of 10 ft. The slates, on the east of and adjoining the ferruginous zone, here carry small bunches of oxidised copper ore.

Shaft B was begun in the hanging-wall country—pyritous blue slate and white quartzite with bunches of calcite and some small irregular patches of chalcopyrite; but struck the "lode" at 50 ft. below the brace. The "lode," as far as could be seen from the tip, consists here of gossany and iron-stained quartzite. Mr. Paton informed me that it is 15 ft. thick, and that in one of the crosscuts sulphides (8% copper) were met over a width of 7 ft. On the 50-ft. level slates, over a width of 10 ft., have been replaced in part by cupriferous pyrite, but the average copper content is probably less than 1%. The stone at grass shows crystals of chlorite in both calcite and pyrite, the chlorite and calcite having presumably segregated from the

country rock, after which replacement of the calcite by chalcopyrite has taken place. That the pyrite is residual from the leaching of chalcopyrite is indicated by its cellular structure, by the absence of limonite (showing that oxidation of the iron has not taken place) and by the presence of selenite, the result of the action on calcite of the sulphuric acid produced during the oxidation of the sulphide (Fig. 23).

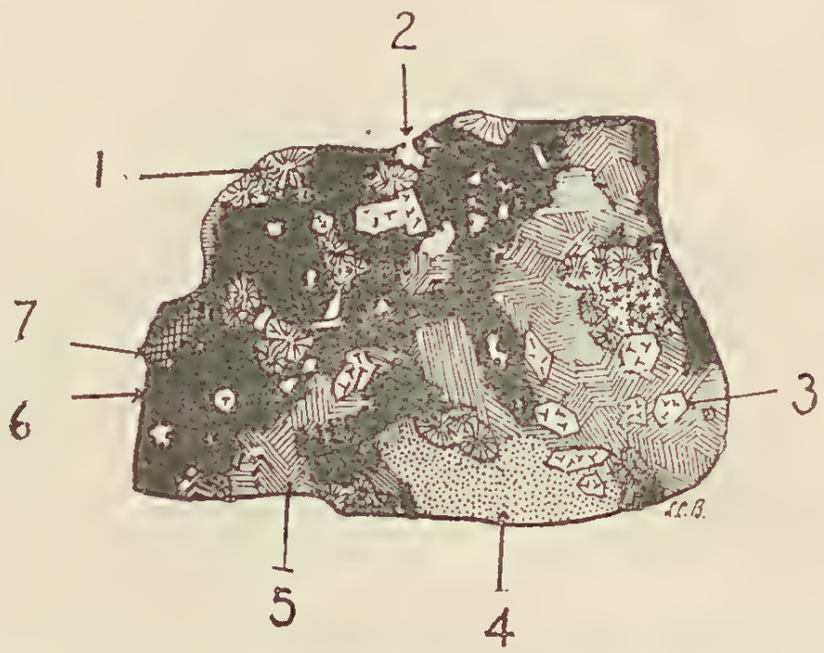


FIG. 23 (NATURAL SIZE).—PYRITIC ORE IN SLATE, B SHAFT, MOUNT WHEELER.

1. *Chlorite.*
2. *Cavity.*
3. *Quartz.*
4. *Country rock.*
5. *Cloudy calcite.*
6. *Pyrite (leached chalcopyrite).*
7. *Selenite.*

Just across the creek, to the south of shaft B, quartz-bearing cellular gossan appears, as irregular crops up to 5 ft. wide and 10 ft. long, in which slight stains of malachite can be seen. A gossany belt 6 ft. wide can be followed south from here.

M.L. 487.—The belt in the northern part, besides being ferruginous, shows considerable kaolinisation. Some bunches of finely cellular gossan were struck in shaft C, just to the south of which crops of that material—evidently irregular bunches—occur over a width of 20 ft.

The pothole on the hilltop to the south is on a crop of slightly copper-stained cellular gossan, 5 ft. and possibly more in width and 1½ ch. in length. Some inclusions of limestone can be seen, but little or no quartz. The gossany belt continues southwards. The sinking of a shaft here is most advisable, as indications are in favour of downward leaching and concentration of copper having taken place. The gossan seems to occur in detached lenses in the belt, and are to be prospected for by driving and cross-cutting.

M.L. 514.—The ferruginous zone continues a few chains into this lease, but no ore-bodies have been exposed. A second iron-stained zone, some chains to the west, is reported to run for miles to the south-south-west.

The limestone crop at the southern end of the lease is on the line of the ferruginous zone, though not visibly connected with it. It is 2½ ch. in length, over a chain in width, and rises 30 ft. above the ground. It consists of granular calcite, slightly coloured internally by oxide of iron and weathering slightly on the surface a dark-brown. Through it are scattered roughly developed elongated quartz crystals of all sizes, quartz being also present as massed crystals and as veinlets. A very little gossan is visible, but only minute traces of copper minerals. The greater part of the limestone is too siliceous for usé as a flux, and, as the copper is not likely to increase with depth, the crop is apparently of no value. The limestone may either have been chemically precipitated on a zone of fracture, and therefore be an integral part of an ore-body, or may be a highly altered body of impure limestone—the latter being the more probale origin.

M.L. 515.—The limestone crop above described continues for over a chain into this lease, but no ore-bodies have been discovered. The limestone crop was pegged out 20 years ago by F. Wheeler for gold (?). On the summit is a depression filled with angular boulders, apparently a fallen-in cave, but its regular sides point to the possibility of its having been excavated by the early prospectors.

Shamrock (M.C. 184).

Mgr., Williams.

Location, Etc.

The Shamrock is about ½ mile north-west of the Soldier's Cap battery, which is 29½ miles by road from Cloncurry.

Its area is 800 ft. × 350 ft. The claim was taken up by Williams early in 1906 for scheelite, but was unmanned when seen by me.

Development.

The workings comprise a number of old cuts and shallow shafts, extending over a distance of 4 ch.

Ore-body.

The crop must have run north and south, parallel to and about 1½ ch. east of the line of the Rose and Thistle line, but no definite idea of its size can be formed owing to the collapse of the workings. It consists of hungry crystalline quartz and crystalline calcite, blocks of the latter in the tips being 2 ft. thick. In the calcite occasional splashes of chalcopyrite and crystals of pyrite can be seen, and the quartz is pierced by acicular crystals of schorl (black tourmaline). Scheelite has been reported to exist here in some quantity (up to 25% by assay), in the northern part of the reef, where schorl is most plentiful, but I was not able to detect any in the stone at grass.

The following is the result of partial analysis of a rough sample (Government Analyst):

Gold	=	trace (less than 9 gr. per ton)
Silver	=	2 dwt. 9 gr. per ton
Magnesia...	=	0·95%
Tungstic Acid	=	nil.

About 5 ch. north of the Shamrock workings traces of copper are visible in segregations of quartz and calcite occurring in crystalline sedimentaries.

May Graham (P.A. ?).

Mgr., Need.

Location, Etc.

The May Graham is 4 miles west of Soldier's Cap.

Its area is 10 ac. This lease was not visited by me, owing to the inaccessibility of the workings.

The three opencuts—50 ft., 15 ft., and 17 ft. deep—have been allowed to fall in.

Output.

The Warden gives only:

1905 ... $9\frac{19}{20}$ tons.
1906 ... 1 ,, (but $20\frac{8}{10}$ tons, Need, Elder.)

Mr. Need, the manager, states that he has shipped:

Total—60 tons, averaging 30% (16 to 38%).

Ore-body.

The May Graham is reported to be a formation 2 ft. wide, in which occur bunches of ore consisting of oxidising chalcopyrite, chalcocite, cuprite, and native copper; and one specimen shown me contained molybdenite.

Weatherley (M.L. 699).

Location, Etc.

The Weatherley lies 1 mile from the Government Well, and $2\frac{1}{2}$ miles north-east of Soldier's Cap.

Its area is 10 ac. The Federal Reward Copper Company now holds the lease. The mine was idle during my visit, and was therefore not visited.

A trench 10 ft. deep is the only development.

Output.

2 tons shipped carrying 19% copper and 4 dwt. 18 gr. per ton gold.*

Ore-body.

A formation 7 or 8 ft. wide is said to carry copper, besides which there is ironstone and a heavy body of ferruginous quartz.

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* *Vide* Federal Reward Copper Company's prospectus.

King Fisher (M.L. 700).

LOCATION, ETC.

The King Fisher lies 1¼ m. north-east of Mount Wheeler.

Its area is 20 ac. Now the property of the Federal Reward Company.

One trench, 12 ft. deep, has been opened.

OUTPUT.

2 tons shipped, carrying 25¾%.*

Mackinlay (M.L. 698).

LOCATION, ETC.

The Mackinlay is about 10 miles north-east of Soldier's Cap and ½ mile from Sandy Creek. It is shown incorrectly on the lease map.

Its area is 40 ac., and it is the property of the Federal Reward Copper Company. Not visited.

There is a shaft on southern boundary.

OUTPUT.

½ ton shipped, carrying 33% copper.*

ORE-BODY.

There is reported to be a carbonate-bearing formation 8 ft. wide, beside an ironstone gossan.

ROBERTS CREEK GROUP.

The Roberts Creek Group lies to the north-east of Soldier's Cap. None of the mines were visited, and it is doubtful if any are being worked. The leases include the following: Boska (M.L. 570), Elma (M.L. 546), M.L.T. (M.L. 476), and Victory (M.L. 525).

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* *Vide* Federal Reward Copper Company's prospectus.

MARTIN CREEK.

The Martin Creek Groups lie between those on Duck Creek, the Florence River, and Soldier's Cap. The district attained some notoriety over the flotation of a gold mine, but has not yet produced much copper. Owing to the limited time available, the mines were not visited by me.

MOUNT McCABE GROUP.

This group includes only three leases.

Mount McCabe (M.L. 363).

Mgr., Pearson.

LOCATION, ETC.

The Mount McCabe is 3 miles east of the Cloncurry River and 2½ miles north of the old Last Call gold mine, which is 24 miles south of Cloncurry.

Its area is 10 ac. The lease is held on option by the West Cloncurry Copper Company, Limited, which began operations early in this year (1907).

LITERATURE.

For title of report, numbered as below, see Introduction.

(16) Mr. Bedford wrote as follows:

This is one of the two true fissure lodes, or, rather, lode channels, on the field. The channel runs south-west and north-east, is 35 ft. wide and quite 800 ft. long. The metal is carried as black oxide in the veins, in a soft chlorite schist, but there are outcrops of specular iron also in the lode channel, which carry low-grade carbonates. Near the summit of the hill an opencut 8 ft. deep and about 6 ft. wide shows a few fine veins of black oxide of copper, but the schists are also impregnated with copper to an appreciable extent. There are many outcrops of iron present, principally specular, and a little as hematite and siliceous limonite. At its lower or northern end the ore channel is cut off by blows of carbonate of lime, which are heavily copper stained at intervals to the base of the hill. . . . A shaft is now down 60 ft., of which the last 45 ft. is in boulders of iron faced with malachite.

ORE-BODIES.

Mr. Cherry, the Gold Warden, after seeing the property, wrote: "The main outcrop strikes northerly and can be seen for a distance of over 200 ft., having a width of from 20 to 40 ft. The lode is composed of kaolin, limestone, and slate carrying copper, while seams of red oxide can be traced through the general formation. . . . Mr. Pearson informs me that the main lode bulks 12·64%."

From the manager's reports it is learnt that in sinking the shaft thin veins and nodules of schist were found to a depth of between

50 ft. and 60 ft., these giving place to "small veins of irony ore through the chlorite schist. A bulk assay from 65 ft. gave a return of 4·4% copper" (8/3/07).

OUTPUT.

1906 ... 4 tons shipped.

McCabe's Hill (M.L. 444).

Mgr., McCabe.

LOCATION, ETC.

McCabe's Hill is located within the catchment of Martin Creek, but its exact position is not known to me.

Its area is $9\frac{8}{10}$ ac.

OUTPUT.

1905 ... 19 tons shipped.

Vulcan (M.L. 268).

Mgr., Entriken.

LOCATION, ETC.

The Vulcan lies $1\frac{1}{2}$ mile north-west of the old Last Call Gold Mine.

Its area is 10 ac.

OUTPUT.

The Warden, in August, 1905, reported:

51 bags,	valued at	£18	7 3
68 ,,	,,	21	13 8
47 ,,	,,	26	11 10

1906, 7 tons shipped.

LEVIATHAN GROUP.

The Leviathan Group is situated on the northern side of Martin Creek, near the Cloncurry River. No particulars are available beyond the numbers of the leases (383, 384, 385), and 412, and their area (each $9\frac{8}{10}$ ac.).

ELDER CREEK.

The Elder Creek groups lie between Cloncurry and Soldier's Cap. Little or no work was going on here at the beginning of 1907, and none of the mines was visited. The ore deposits are reputed to be small and of little account.

MOUNTAIN HOME GROUP.

The group centres in the freeholds on Mount Norma, or Norna, and contains, besides those given below, the Come by Chance (M.L. 651), of which no particulars are available.

Mountain Home (M.F.s 2822, 2823, 2821, 2820, and 2659).

LOCATION, ETC.

Mountain Home (M.F. 2821) is on the southern slopes of Mount Norna, which lies 17 miles south-east of Cloncurry; M.F. 2823 is on the northern slopes of the same mountain; M.F. 2822 is ½ mile to the north-north-east; M.F. 2820 is 3 miles north-east of Mount Norna; and M.F. 2659 is ½ mile north of M.F. 2820.

The following are the areas of the blocks:—2821, 2823, and 2822 are each 160 ac.; 2820 is 120 ac.; and 2659 is 40 ac. in extent.

OUTPUT.

1906 ... 14$\frac{19}{20}$ tons shipped.

LITERATURE.

For titles of reports, numbered as below, see Introduction.

(2) Mr. Jack's description is as follows:

Mountain Home.—Mount Norma lies about 10 miles south-east of the Gilded Rose. It is a very conspicuous hill, especially as seen from the Hughenden road. It is of vertical slate (or rather shale) with a north-west strike, and is intersected with reefs or veins of quartzite. On its eastern side is the Mountain Home Copper Mine. The mine is one of the quartzite reefs above referred to, which runs north-north-west and is almost vertical, but has a slight underlie to east-north-east. The reef is seamed with copper ore, especially in the back (up hill). In the upper part of the lode, where the reef stands up like a wall on the hill side, the copper ore is represented by stains (stalactitic coatings) of green carbonate. The lode is a peculiar one in many respects, from the association of minerals. It yields green carbonate of copper, ferruginous red oxide of copper, enclosing numerous garnets, asbolane (manganese and cobalt) and numerous dendritic markings in binoxide of manganese.

From the hardness and toughness of the siliceous matrix of the ore, the Mountain Home will probably be an expensive mine to work, but I should expect it to have a large output of ore of good quality. The labour conditions necessary for securing the land have been fulfilled for the most part by the construction of a dray road up the hill; and the mine is very little opened out.

(7) The following is taken from Mr. Rutherford's report:

The Mountain Home (M.F. 2821) Mine is situated half-way up the eastern side of Mount Norma, a conspicuous hill 18 miles south-east from Cloncurry in a direct line. The "mine" consists of a 6 ft. by 4 ft. shaft sunk vertically 10 ft. and then 40 ft. on an underlay of 70 degs. to the east. The *raison d'être*

of the shaft is an irregular crack in the ferruginous sandstone, which is about 1 ft. wide at the surface, but peters out before the bottom of the shaft is reached. This probably carried copper; plentiful stains on the rocks at surface on the sides of an irregular excavation indicates the removal of a certain amount of ore from what must have been a bunch occurring at the surface. No other indications of ore were seen in the vicinity.

Lady Norma (M.L. 694).

Mgr., W. Carroll.

Location, Etc.

The Lady Norma is on O'Toole Creek, 16 miles from the railway.

Its area is 20 ac. The Federal Reward Copper Company now holds the lease.

There is one shaft 50 ft. deep.

Ore-body.

There is reported to be a large crop of ironstone gossan and copper carbonates and 3 ft. of ore in the shaft bottom.

Elder Bornite (701).

Mgr., W. Carroll.

Location, Etc.

The Elder Bornite is on the Elder River, 18 miles east-south-east of Cloncurry, 2 miles south of the Winton road, and 7 miles north-east of Mount Norna.

Its area is 10 ac. The Federal Reward Copper Company, which holds the ground, has not yet begun work here.

Lone Hand (M.L. 681).

Mgr., Wareham.

Location, Etc.

The Lone Hand is 3½ m. north of Mount Norna.

Its area is 10 ac.

Output.

1906 ... 5 tons shipped.

ELDER GROUP.

The Elder Group comprises, besides those mentioned below, the Dromedary (M.L. 510), Laird (M.L. 464), and Montana (M.L. 372), particulars of which are not accessible.

Elder (M.L. 415).

Mgr., Wright.

LOCATION, ETC.

The Elder is located on the creek of the same name. Its area is $9\frac{8}{10}$ ac.

OUTPUT.

1906	...	$20\frac{8}{20}$ tons.

Three Jokers (M.L. 463).

Mgr., Moniz.

LOCATION, ETC.

The Three Jokers lies 4 miles west of Mount Norna. Its area is $9\frac{8}{10}$ ac.

OUTPUT.

1905	...	$3\frac{10}{20}$ ons
1906	...	4 „
Total ...	...	$7\frac{10}{20}$

PUMPKIN GULLY.

This group is on the main Richmond road, between Cloncurry and the open downs to the east. A little work is occasionally done here, but, as most of the holdings were under exemption at the end of last year, it was not thought worth while to pay a special visit to the locality. The only workings seen, therefore, were those in immediate proximity to the road.

From my own rapid traverse of this part of the district the opinion was formed that it is an area of considerable metamorphism, chiefly of sedimentaries (including limestones), though eruptives are not wanting. The strata are tilted and the quartzites are interbedded with the slates.

Metamorphism has been less intense here than in any other part of the Cloncurry district—traces of fossils (*Stromatopora*) being distinguishable in the limestones. This may furnish an explanation of the comparatively small size of the ore-bodies—viz., that concentration of the copper has not been brought about owing to the original cupriferous silicates of the eruptives not having been broken up.

The following quotations may prove of interest, though not in agreement with my views.

(2) Mr. Jack refers in the following terms to the Pumpkin Gully country:

> Eastward towards the Mount Douglas mines, similar country prevails, with the addition of peculiar rugged knobs of granular quartzite. Unless these latter be the dicharge-pipes of "geysers" which poured out hot water containing silica in solution, I am at a loss to account for them.
>
> On the north bank of *Pumpkin Gully*, a copper lode (nearly vertical) runs from south-west to north-east. It has a large cap of red ironstone, and green fibrous carbonate of copper, with some very blue azurite. Part of the gangue (which is siliceous) is mixed with red oxide of copper and "grey ore" (sulphide of copper and antimony). The lode is traceable for a quarter of a mile across Pumpkin Gully; only one hole has been sunk, about four feet deep.

(4) Mr. Cameron, speaking generally of the Pumpkin Gully leases in 1900, said:

> . . . No attempt, however, has been as yet made to systematically prove the value of any of these leases, and up to the present no lode of any great importance has been discovered. The surface of the ground is comparatively level, and the copper outcrops are considerably concealed by surface accumulations. The outcrops are numerous and scattered, and often afford very rich ore. They are, however, small, and can as yet only be taken as indications of the presence of copper in the locality, whatever they may develop into when systematically opened up. The copper occurs as glance and carbonate chiefly, but also as red oxide, bornite, and chrysocolla in association with iron oxides. It is found generally in a hard siliceous matrix similar to that found at the old Cloncurry Mine, which runs in seams following the bedding of the slates and schists.
>
> On many of the leases no work of any kind has been done, though they show indications of ore. In most cases these indications consist of small patches of rich ore occurring in belts following the bedding of the country rocks. As these have not been opened out in any way their true significance is obscure, but they are certainly worth the spending of a little money in systematic prospecting work. . . .

The remaining leases in this neighbourhood show numerous patches of good ore in seams in the bedding planes of the country rock, but the outcrops are detached, and without, in many cases, even the removal of the loose boulders and *débris* of the weathered country rock, it is impossible to judge of their extent or their connection with each other. As far as I could see, none of them are indicative of true fissure lodes, but they are all apparently veins or impregnations of the country rock.

(7) Mr. Rutherford sums up:

This group consists of small outcrops of quartzite, almost invariably associated with oxide of iron and stained with copper carbonate. They occur in country which is comparatively flat in schists and slates, and always follow the bedding of those rocks. The ridges in the vicinity are composed of sandstone often altered to quartzite, but still showing bedding. This rock, on examination, almost invariably shows stains of copper carbonate. It is my opinion that the copper has been leached out of this overlying sandstone and redeposited in a concentrated form along foldings and bedding planes of the underlying schists and slates. In no case did I see indications of fissure lodes. These small pockets, occurring as they do above water-level, are excavated without much expense, and, owing to the extraordinary richness of the ore, this pays to be carted to the railway. I consider the Homeward Bound group of leases of little value, as in most cases the ore bodies seem to have been mostly removed.

HOMEWARD BOUND GROUP.

This group includes the south-western leases.

Homeward Bound (Extended M.C. 331).

Mgr., Brown.

LOCATION, ETC.

The Homeward Bound lies about ½ mile east of Pumpkin Gully, and 12 miles east of Cloncurry.

Its area is 600 ft. by 350 ft. This claim and two small leases (Mount Douglas and Flying Dutchman) have been pegged out on the abandoned Homeward Bound lease.

LITERATURE.

For titles of reports see Introduction.

(2) Mr. Jack says only:

Three hundred yards east of the Flying Dutchman is the *Homeward Bound* Copper Lode. It runs north and south. The shafts have become unsafe, but a little of the ore is lying about—green and blue carbonates, and some red oxide and native copper. The copper ore is said to have contained gold. A good deal of ore from this mine is stacked at the Queensland machine.

(4) Mr. Cameron wrote of the original holding:

Lease No. 158 shows an outcrop of ore called the Homeward Bound. An excavation about 30 ft. by 20 ft., and perhaps 6 ft. in depth, has been made on the surface of the ground, and good ore is reported to have been obtained from a shaft on the south-east corner of the excavation. At the north-west corner of this excavation a shaft has been put down 75 ft., and a drive from the south-east corner of the shaft goes east 30 degs. south for 17 ft., and then north 30 degs. east for 15 feet. There are highly-inclined slates striking about north-east in the shaft, and crystallised limestone and felspathic sandstone in the drive. There is no sign of ore or lode material. Ore is at present being obtained on the surface some 30 ft. east of this shaft, and about 20 tons have been stacked. The ore occurs as blebs of red oxide, glance, and radiating

fibres of green carbonate in a siliceous matrix or quartzite. I could see no indications of a well-defined lode, nor does there appear at present to be any great body of ore. The outcrop is, however, considerably hidden by surface accumulations. An ore purchase-note from the Queensland Smelting Company, shown to me by Mr. Henry, as of ore from this outcrop, gave a return of 27·95 per cent. copper for a bulk sample of a few tons. The ore stacked could be easily picked to give a considerable amount of ore of this value. A few shallow trenches and shafts along the apparent line of deposition of the ore would soon serve to show whether the ore-body is continuous for any distance. The drive from the shaft mentioned above if continued a few feet would indicate whether the ore-body reaches down to the 75-ft. level, or whether it is merely a lenticular patch of ore at the surface of the ground.

In the north-west corner of Lease No. 158 is another outcrop of copper ore on which a pit some 18 ft. deep has been sunk. It shows ferruginous and cupriferous quartzite apparently occupying a fissure striking about north 20 degs. east and dipping steeply to east 20 degs. south. The lode is about 2 ft. wide, and shows good copper ore. This lode is generally supposed to be a continuation of the Homeward Bound, though on what evidence I have been unable to determine.

There is another shaft some 300 yards south-west from the Homeward Bound, but it has tumbled in. Some ferruginous green and blue carbonates with splashes of red oxide are seen on the surface.

(7) Mr. Rutherford states:

An irregular excavation 30 ft. × 20 ft. and 4 ft. to 6 ft. deep has been made to remove this outcrop, from which 200 tons of rich ore are said to have been sent away. According to Mr. Henry, none of this ore assayed under 39 per cent., and was mostly carbonate and an intimate mixture of carbonate and glance (the result of oxidation of the glance) known locally as grey ore. . . . In the south-east corner of the surface excavation an irregular hole has been sunk 12 ft. and a drive put in to north 45 degs. west for a distance of 20 ft. I was able to examine this drive, and found it to be in a felspathic sandstone showing green stains of copper carbonate on roof and sides leached out of the overlying outcrop, but I saw no ore nor lode formation. This seems to have been a lenticular deposit of rich ore at the surface. With the exception of a few tons lying at grass, all the ore seems to have been removed.

Development.

On the southern side of the Richmond road an opencut, a trench, and a shaft are to be seen. The opencut, which runs north and south is 50 ft. in length and 15 ft. deep. An irregular trench 10 ft. in length lies 10 ft. to the south-east of the opencut. The shaft is 30 ft. deep and lies 5 ft. east of the opencut. These workings can scarcely be the same as those referred to above by earlier observers.

Ore-body.

Little can now be seen of the ore-body, except at the northern end of the opencut, where it is 1 ft. wide. Presumably there have been ill-defined bunches of ore, including limonite with radiating malachite.

Mount Douglas (M.L. 307).

Mgr., Moniz.

Location, Etc.

The Mount Douglas is on the eastern side of the abandoned Homeward Bound lease.

Its area is 4 ac.

Flying Dutchman (M.L. 418).

Mgr., Crabb.

LOCATION, ETC.

The Flying Dutchman lies 10 ch. to the west of the Mount Douglas.

Its area is 5 ac.

LITERATURE.

For titles of reports see Introduction.

(2) Mr. Jack's report is as follows:

Half a mile to south-south-east is the *Flying Dutchman*. It runs east and west and underlies to the north. The country is sandstone, with fine grains of mica. The matrix of the lode or reef is sandy (siliceous). The mine was originally taken up as a gold reef, and Mr. Macphail informed me that the stone, when crushed at the Queensland machine, averaged 1 oz. 3 dwt. of gold to the ton. All that remains to be seen at the shaft is a quantity of glassy quartz, with green fibrous (radiated) carbonate of copper, and some grey copper ore.

This probably refers to the western shaft on the Homeward Bound.

OUTPUT.

1904 ... 18 tons, shipped by Crabb; source doubtful.

King John (M.L. 417).

Mgr., Miller.

LOCATION, ETC.

The King John adjoins the old Homeward Bound on the north-west.

Its area is 5 ac.

Baroondah (M.L. 137).

LOCATION.

The Baroondah lies ¼ mile east of the Copper Quarry.

LITERATURE.

For titles of reports see Introduction.

(4) Mr. Cameron reported:

Lease No. 137 shows an excavation about 12 ft. long by 9 ft. broad and 5 ft. deep, from which some 3 or 4 tons of ore showing copper glance and carbonates in a quartzite gangue have been taken. About 140 yards to north 75 degs. west from this excavation is a trench, 5 ft. long by 3 ft. broad and 5 ft. deep, which exposes about 2 ft. of siliceous ore carrying ferruginous green carbonates. The country rock is siliceous schist.

(7) Mr. Rutherford reported:

It shows an irregular excavation about 12 ft. long by 5 ft. deep in siliceous schist, from which a few tons of ferruginous quartzite stained with copper have been removed and are lying at grass. On the same lease 200 yards to the south-east 7 tons of 30 per cent. ore have been sent away from the surface.

Musical Union (M.L. 465).

Mgr., Brown.

Location, Etc.

The Musical Union lies 1 mile south-east of the Copper Quarry. Its area is 5 ac.

Burleigh (M.L. 136).

Location.

The Burleigh lies 1½ mile south-east of the Homeward Bound. It is now abandoned.

Literature.

For titles of reports see Introduction.

(4) Mr. Cameron remarks:

Lease No. 136 shows a low ridge of hornblende rocks and limestone striking about north-west. Several small outcrops of copper ore are seen, but so far they do not appear to be of any great importance. The ore is chiefly peacock ore with earthy green carbonate and iron oxide, and occurs associated with quartz and calcite in what are apparently small veins following the bedding of the country rock.

(7) Mr. Rutherford wrote:

It shows on the surface small veins of quartz carrying iron and a little copper, principally in the form of peacock ore. Several small trenches have removed most of the ore. The country is hornblende schist, and the quartz follows the bedding of the rock to north 30 degs. west.

Copper Quarry (M.L. 143).

Mgr., Brown.

Location, Etc.

The Copper Quarry is 9 miles east of Cloncurry, and about ½ mile east-south-east of where the Richmond road crosses Pumpkin Gully.

Its area is 10 ac.

Literature.

For title of report, numbered as below, see Introduction.

(4) Mr. Cameron wrote:

Lease No. 143 shows talcose schist striking east and west. A surface excavation on an outcrop of copper ore shows these schists to be heavily impregnated and replaced by copper glance over a width of about 5 ft., and some rich glance ore has been extracted. The schists show evidence of being copper bearing for some 35 yards in breadth south of this excavation, and for a considerable distance east along the strike of the beds. This outcrop holds out a prospect of being able to turn out a considerable quantity of glance ore that could be easily picked to assay 25 or 30 per cent. The occurrence of the ore is, however, irregular, as it has apparently been concentrated into masses here and there through the schist. It does not give much indication of its presence on the surface.

Output.

1904	...	26	tons,	shipped by	Brown and party;	source	doubtful
1905	...	9	,,	,,	S. Brown	,,	,,
	...	$2\frac{10}{20}$	,,	,,	S. Cowing		
1906	...	$1\frac{2}{20}$	,,	,,	S. Brown	,,	,,
		$38\frac{12}{20}$					

Raleigh Heights (M.L. 373).

Mgr., Carew.

Location, Etc.

The Raleigh Heights lies 5 ch. to the north-north-west of the Copper Quarry. The Richmond road crosses the southern corner of this lease.

Its area is $9\frac{8}{10}$ ac.

Literature.

For title of report, numbered as below, see Introduction.

(4) Mr. Cameron wrote of the old lease:

Lease No. 139 shows a prominent ridge of altered and vertical felspathic sandstone about a quarter of a mile in length. A few potholes expose indications of copper here and there through the sandstone, but do not disclose any ore of value.

(7) Mr. Rutherford says:

This area is taken up to include a metamorphosed sandstone ridge running north 80 degs. east. The sandstone is stained in places with green carbonate. A small hole into the side of the hill is completely cleaned out of any ore which it may have contained. I examined the whole ridge, but saw nothing beyond a few stains as mentioned.

EAGLEHAWK GROUP.

This group lies to the north of the Homeward Bound.

Eaglehawk (M.L. 454).

Mgr., Miller.

Location, Etc.

The Eaglehawk lies 3 miles west of the 18-Mile Hotel on Fisher's Creek.

Its area is 5 ac.

Literature.

(4) Mr. Cameron wrote of the old lease:

Lease No. 48 shows a pit sunk about 12 ft., on what is apparently a north-west and south-east lode. About 12 tons of ferruginous siliceous lode material containing large blocks of copper glance have been stacked. The width of the lode cannot be judged of, nor has its continuation been proved by prospecting work.

Output.

1906 ... 10 tons shipped.

Crow's Nest (M.L. 455).

Mgr., Miller.

Location, Etc.

The Crow's Nest lies $\frac{1}{2}$ mile south-south-west of the Eaglehawk.

Its area is 20 ac.

Salisbury (M.L. 142).

Location.

The Salisbury lies 1 mile north-east of the Homeward Bound and within 5 ch. to the north of the Richmond road. The lease has now been forfeited.

Literature.

(4) Mr. Cameron wrote:

On Lease No. 142 a shaft was sunk to a depth of about 20 ft. and a few tons of copper ore extracted. It shows blebs of glance and peacock ore with radiating fibres of green carbonate associated with quartz and calcite. There does not appear to be any great body of ore present, nor is it possible with the present prospecting work to determine the direction in which the ore-bearing material is running.

(7) Mr. Rutherford states:

This is taken up on a small ferruginous quartzite outcrop showing copper stains. The only work done consists of a shaft, 16 ft. deep, which shows small ferruginous quartz veins following the bedding of the rock. No copper ore is seen in the shaft. The outcrop is said to have been worked for gold.

Cammie (M.L. 477).

Mgr., Miller.

Location, Etc.

The Cammie lies 1 mile east-south-east of the Crow's Nest, and 1 mile west-south-west of the 18-Mile Hotel.

Its area is 5 ac. The ground was deserted in October, 1906.

Literature.

For title of report, numbered as below, see Introduction.

(4) Mr. Cameron referred to the old lease thus:

Of the group of leases lying further to the east, *Lease No. 56* shows a trench about 18 ft. in length and 14 ft. in depth, which exposes a seam of siliceous copper ore some 2 ft. to 3 ft. in width. The copper occurs as glance and carbonate associated with quartz and ferruginous silica. The ore occurs in slate, and runs with the bedding of the rock, which strikes here about east 30 degs. west.

Development.

There is a shaft 15 ft. deep adjacent to the road.

Ore Deposit.

A small lenticular bunch of very siliceous ore, containing cuprite and malachite and up to 3 ft. in width, has been removed from here. It ran east and west, while the altered sedimentary country, including micaceous-slate, strikes north and south, dipping steeply to the east.

This appears to be only one of many small bunches occurring in a ferruginous belt, distinguished by a very red soil.

King William (M.L. 462).

Mgr., Miller.

LOCATION, ETC.

The King William is understood to lie 2 miles south-south-east of the 18-Mile Hotel on Fisher's Creek.

Its area is 5 ac.

MONAKOFF GROUP.

This group includes only Freehold No. 15, which is located on a branch of Courtenay Creek, a tributary of the Williams River.

Monakoff (M.F. 15).

LOCATION, ETC.

The Monakoff lies 13½ miles north-east-by-east of Cloncurry.

Its area is 80 ac. The property is now held by the Monakoff Company, which pays a royalty to the Railway Company.

LITERATURE.

For titles of reports see Introduction.

(4) Mr. Cameron wrote:

The Monawagh Mine is a prominent ridge of copper-bearing country, running in a north-east and south-west direction. The south-western portion, which is divided by a watercourse from the north-eastern, presents a wall of green-stained rock to the south-east. I am informed that an opencut at the north-east end of the ridge exposed a vein of copper ore about 2 ft. in thickness, interbedded with the schist. The ore is siliceous and ferruginous, and carries copper in the form of glance and tile ore. About 300 yards on the north side of the ridge a trench 35 ft. long, 3 ft. wide, and 8 ft. deep exposes a small lode of siliceous ore carrying bornite and glance.

(7) The following is taken from Mr. Rutherford's report:

This property . . . consists of a prominent ridge of sandstone still showing bedding in places, and much contorted and altered to quartzite in others. The surrounding country is micaceous schist. Approaching this ridge from the north a lenticular hole 10 ft. deep at its deepest part and 30 ft. long was examined. According to the digger who showed us this property 18 tons of 37 per cent. ore were sent away from this excavation. The ore as usual was associated with iron and quartz. A heap at grass shows the iron impregnated with iron pyrites. Ascending the hill the sandstone ridge is reached. It runs 20 degs. south of east, and is stained in places a bright green with copper salts. Starting at the western end of the ridge along the line of outcrop, the first cutting is 15 ft. long by 12 ft. deep. It shows the sandstone to be soft and ferruginous, and reveals the staining of copper to be confined almost entirely to the upper part of the trench. Continuing east a hole 3 ft. deep is in barren sandstone. A second cutting shows quartzite 3 ft. across stained with carbonate. Beyond this cutting is a shaft which is said to have been sunk 50 ft., but has been filled up with *débris* to within 20 ft. of the surface. An examination of the waste dump showed nothing but the country rock. Farther to the north-east across a gully is a second bed of sandstone very similar to that just described, but no work has been done on it.

CHINAMAN CREEK.

Chinaman Creek occupies a wide flat-bottomed valley, which is bounded on the east by a low table-topped range, and on the west by the Corella peneplain.

CASSIDY' SWELL GROUP.

The group is on the eastern side of the Chinaman Creek valley.

The Poseidon has lately been taken up in the vicinity of the Thistle.

Thistle (Extended M.L. 248).

Mgr., Corney.

LOCATION, ETC.

The Thistle lies 2 miles south-south-east of Cassidy's 9-Mile Well, at the crossing of the Boulia road and telegraph line, on Chinaman Creek.

Its area is 1,200 ft. by 350 ft.

DEVELOPMENT.

A costean (No. 1 cut), 5 ft. deep and 7 ft. long, has been opened 2 ch. south-east of the north-western corner peg, and a drive continues 6 ft. from the eastern end. At 1 ch. to the south there is a shallow pothole, 10 ft. beyond which is No. 2 cut. This is angle-shaped, being 6 ft. deep and 4 ft. wide, with one arm running 10 ft. west and another 8 ft. south. A second pothole lies $\frac{1}{2}$ ch. south of No. 2 cut, and the main shaft, $\frac{1}{2}$ ch. to the east, is 70 ft. deep, and has a cross-cut for 34 ft. east at the bottom.

OUTPUT.

$\frac{3}{4}$ ton shipped.

ORE-BODIES.

The country is bluish clay-slate,* dipping 2 in 1 to the east. This rock has suffered alteration, and is shattered over a distance of at least 3 ch. from the northern end of the claim and over a width of 1 ch. near the main shaft. An outcrop of schistose micaceous and granular hæmatite, 1 ch. long up to 25 ft. wide, and rising 4 ft. above the surface, occurs on the eastern boundary of the claim $2\frac{1}{2}$ ch. east of the shaft. Occasional boulders of yellow jasper, possibly replaced limestone, and also of limonite, are to be seen, and some copper stains can be distinguished, but no body of copper ore is to be expected here. Other crops of hæmatite have been found 4 ch. to the south, and they are reported in numbers in the low range, $\frac{3}{4}$ mile to the east.

In No. 1 cut a gossany crop has been opened to 5 ft. depth, where the formation is barren, though 2 tons of gossan and slate, stained

* The kangaroo lickholes on the flats north-west of the claim are of interest. They are trenches 18 in. long by 6 in. wide and 6 in. deep, as well as holes 6 ft. deep. The soil here is reddish and clayey but tasteless.

with azurite and malachite, and containing probably 10% copper and 5% silica, was obtained from irregular joints near the surface. There are only stains of copper carbonate in the drive.

The pothole to the south is in bleached clay-slate, the joints of which have been filled or stained with carbonates, and about 1 cwt. of 5% ore has been picked out. The country between this hole and No. 1 cut is a ferruginous slate, the joints of which are coated with black limonite.

No. 2 cut is in bleached and iron-stained clay-slate, with a little gossan and carbonate and silicate stains on joints. There are, at grass, about 4 tons of 5% ore, and 18 cwt. of 45% ore is said to have been shipped, while the 15 tons in the tip probably contain 1% copper, and may be of value as an aluminous flux.

The shaft is sunk on the eastern side of a formation, 10 ft. wide. There is little probability of anything payable being found here, but the open ferruginous joints indicate the possibility of the formation being copper-bearing towards water level. The result of driving has been disappointing because of faulting throwing the formation, proved in No. 2 cut, back from the shaft.

A tongue, 20 ft. across, of formation, comprising slate fragments in a ferruginous matrix, projects towards the hæmatite crop for 1½ ch. east of the shaft.

The southernmost pothole is in poor siliceous ore.

TOWN.

GREAT AUSTRALIA GROUP.

The group includes chiefly freeholds. The Great Australia is the only lode of importance.

Great Australia (F. Al.).

Mgr., G. E. Moore.

LOCATION.

Freehold A1 adjoins the township of Cloncurry on the south, the Great Australia workings lying a mile south-east from the main business area.

The major part of the holding is low-lying, the Great Australia and Mount Pisa ridges forming the most marked rises, and the Wanderer Creek the most noticeable depression.

Of timber larger in size than brush there is of course little left, because of mining and smelting operations in past years, and the needs of the township.

AREA.

The area of the freehold is 640 ac., and it is square, each side being therefore a mile in length.

The property is now in the hands of the Queensland Exploration Company, Ltd., whose manager was absent during my inspection.

HISTORY.

The Great Australia was taken up, as a 640 acre mineral selection, by Mr. Ernest Henry prior to 1868 (according to records in the Warden's Office), but is now held as freehold under the Mineral Lands Act of 1872. The first work was done in 1871 by Mr. Henry, who sank several shafts to water-level, and despatched rich ore to Normanton.

In 1884 a company was formed, took over the mine and began mining operations, the number of men employed numbering between 200 and 300.

During 1885, 60 men were employed. Smelting, in two water-jacket furnaces of 50 tons capacity, was initiated, with the use of charcoal fuel; and 253 tons of ore were smelted, the copper produced being free from arsenic.

During 1886, only 40 men were engaged, but 200 tons of copper were shipped, *viâ* Normanton, the cartage to that port being £6 per ton.

In 1887 the number of men employed fell to 18, but 1,010 tons of ore were raised during the first half of the year, and 190 tons of copper were run from the furnaces.

Early in 1889 work ceased because of the low price of copper, and the mine then lay idle for 17 years.

Towards the end of the year 1906 the Queensland Exploration Company, which had taken over the property earlier in the year, began cleaning up the old workings.

From Press reports it is learned that during the present year the main shaft, south of the big crop, has been sunk 112 ft. (17/4/07), in formation carrying stringers of native copper. The tunnel shaft, 117 ft. deep, appears to have passed through the ore bodies (proved in the adit—L.C.B.), which have been tapped in a western crosscut, 27 ft. long; but the eastern crosscut, 100 ft. long, seems to have failed to locate ore.

Literature.

The full titles of reports will be found in the Introduction.*

(1) The Wardens gave a statement of output, but no account of the deposit worked.

(2) Mr. (now Dr.) Jack describes three lodes:—(*a*) forming the main crop one-fourth of which Mr. Jack estimated would contain 35%; and (*b*) and (*c*) cross lodes. In the last were exposed masses of red oxide of copper often intimately mixed with small nuggets of native copper and occasional crystals of black oxide of copper. The following is the full account:

The "*Great Australian*" Copper Mine lies between the last-mentioned ironstone hill and the township. It may almost be described as a mountain of copper. It occurs as a ridge about 30 feet in height and over 100 yards in length, with a general trend from north to south. It is intersected by two cross lodes, and has several branches. A detailed description is in preparation. At present I can merely say that numerous trenches and shafts only lead to the conclusion that "there is no end to it." The most valuable ore is the red oxide, which is obtained in great purity, and often contains large masses of native copper. The cap of the lode is composed of a siliceous matrix with green carbonate.

Lode A.—The most conspicuous feature of the mine is the outcrop of a lode, which runs north 33 degrees west, and stands up to an average height of about 20 feet above the general level, for about 80 yards. The lode underlies to west 33 degrees south, at an angle of 50 degrees. The matrix is a brownish quartzite, very tough and hard, and frequently enclosing small pieces of native copper, interspersed through the matrix irregularly; but as a rule, in veins parallel to the general run of the lode, are masses of green carbonate of copper and red oxide, the latter often in crystals, and as nearly as may be, chemically pure. The ore has been quarried to a small extent on the crown and south-western side of the hill. If the whole hill were quarried out I believe that on a rough estimate quite a fourth of the entire mass would yield ore containing 35 per cent. of copper and over, after the rejection of the siliceous matrix and portions of ore too much mixed up with the matrix.

Lode B.—At the S.E. end of the hill the A lode is shifted about 90 feet to the S.W. by a cross lode (B) whose course is east 40 degrees north. This cross lode is traceable for over 100 yards to the N.E. of the lode A, but the first 20 feet or so are obscured by a talus of *débris* from the outcrop of lode A. Lode B is nearly vertical, but underlies a little to north 40 degrees west. Its most conspicuous feature is a rock, 32 feet in length, 8 feet broad, and averaging 6 feet in height. This rock is a mass of quartzite like that which forms the matrix of lode A, and has joints and pockets coated with

* Messrs. Jack and Rutherford give particulars of another lode (the Wanderer) on the freehold, but this was not inspected by me.

green carbonate of copper. To west 40 degrees south of the rock and in the same line, the cap of an ironstone and copper lode extends for 17 feet, when it passes under the talus already referred to. At the other end of the rock (to east 40 degrees north), the lode is traceable, either *in situ* or in blocks, for 260 feet. Lode B occurs in a line of fault with a downthrow to the north, and is of later date than lode A.

To the south of lode B, lode A is continued in a general direction of south 10 degrees east, for a distance of about 24 yards. It appears here to be narrower and poorer (at the outcrop) than on the other side of the cross lode, and to bifurcate towards the south end.

Lode C.—The south end of this (which may be called the second section of lode A) is intersected by a second cross lode (lode C) running east 35 degrees north. This lode has been worked open-cast for about 110 feet to east 35 degrees north from the crossing of lode A. The ground rises in this direction, and the present face of the working is about 20 feet high. The lode varies from 2 to 12 feet in width and is nearly vertical. The faces and sides of the workings expose masses of red oxide of copper of great purity, often intimately mixed with small nuggets of native copper. Occasional crystals of black oxide of copper are met with in this cutting. The oxide is traceable for a considerable distance beyond the working.

What may be called the third section of lode A extends in a general direction of south 15 degrees east from lode C. It has been worked open-cast for about 50 feet from the crossing of lode C, and has yielded much rich ore. The south face of the open-cast shows a mass of very pure red oxide bound together by masses of native copper.

From this open-cast no work has been done for the next nineteen feet (though the lode is visible on the surface), when an underlie shaft has been sunk on it, in rich ore. The lode is untouched for about 40 feet from the shaft, when it is again worked open-cast for a distance of 90 feet. The workings here have tumbled in, but enough is still seen to prove that the lode continues undiminished in size, and yields rich oxide ores.

(4) Mr. Cameron brings Dr. Jack's description up to date 1900 thus:

Since Mr. Jack's visit an open cut has been worked along the centre, and apparently the richer portion of the main outcrop mentioned as Lode A, starting from its north-western termination and going in a south-westerly direction along the line of lode. The open cut is about 15 feet across, and starts from a point about 20 feet above the base of the outcrop. It runs in a south-easterly direction for about 70 feet, ending in a face some 20 feet in height. This face shows red oxide and native copper in splashes through a brown quartzite. Several small stacks of ore are lying about at the foot of the outcrop, and appear to have come from the tunnel. They seem to support the view that the ore can be easily picked to a high percentage. The ore-bearing portion of the outcrop, as shown by the sides of the open cut, dip to west 33 degrees south at about 60 degrees. A tunnel has been driven in, apparently with the intention of meeting the ore body at a lower level than the floor of the open cut. It makes an acute angle with the direction of the open cut, starting from the western side of the outcrop and going almost due east. It is 18 ft. across, 8 feet high, and about 60 feet long. It does not appear to have reached to the main ore body. The walls show hard brown quartzite with veins of white quartz, and they are stained green from copper salts leached from the surrounding rock. Otherwise they do not show indications of containing a payable proportion of copper. About 15 feet from the mouth of the tunnel a drive goes in to the right for about 30 feet, and meets a shaft from the surface here only a few feet up. The shaft is continued down for a distance of about 40 feet. None of these workings, except the open cut on the outcrop of the lode, appear to be in ore of much value, and no further work appears to have been done on the main outcrop of Lode A north of where Lode B crosses it.

South of the junction of Lode A with Lode B the outcrops described by Mr. Jack are a confused mass of neglected workings, tumbled-in shafts, mullock heaps, and decayed surface structures. One of these shafts is said to have been 160 feet in depth. They are, however, all inaccessible, and it is impossible to gain any reliable information as to the character or value of the lode met with in them. The workings would require a considerable sum of money to put them in order. . . . .

I was unable to get any reliable information as to the value of the ore in the lower levels, but it appears that the water level was reached and sulphide ore obtained. The smelting of the ore seems to have been the difficulty that was never satisfactorily overcome, and this failure, together with the drop in the price of copper, are the causes to which is attributed the closing down of the mine.

(6) Messrs. Rutherford and Kitchener in describing the geology of the No. 1 Freehold, say:—

The country is flat and consists of felspathic slate standing nearly vertical. Overlying the slate and scattered irregularly over the surface is a metamorphosed sandstone highly contorted and completely altered to quartzite in places. The ore occurs (1) in a bed of vitreous yellow quartzite, which stands up 30 ft. above the general level for a distance of 80 yards, and (2) in the slate associated with iron oxide and quartz in a succession of lenticular deposits to the south-west. . . . It is possible some rich pockets of ore may still remain undiscovered, but the expenditure which would be entailed prospecting for these would be greater than any return which could legitimately be expected.

(12) Messrs. Alex. Hill and Stewart gave few details beyond the amount of seconds at grass and the contents.

Development.

The Great Australia workings comprise three opencuts, an adit and nine shafts. Only the northern cut, the adit and tunnel shaft were accessible to me.

The northern opencut, on the big crop, is 30 ft. long, 20 ft. wide, and 10 to 15 ft. deep.

The main opencut, to the south-east of the big crop, and between the main northern and Tangye's shafts, really represents stoping done from the water-level.

Tangye's opencut is a fallen in stope to the south of Tangye's shaft.

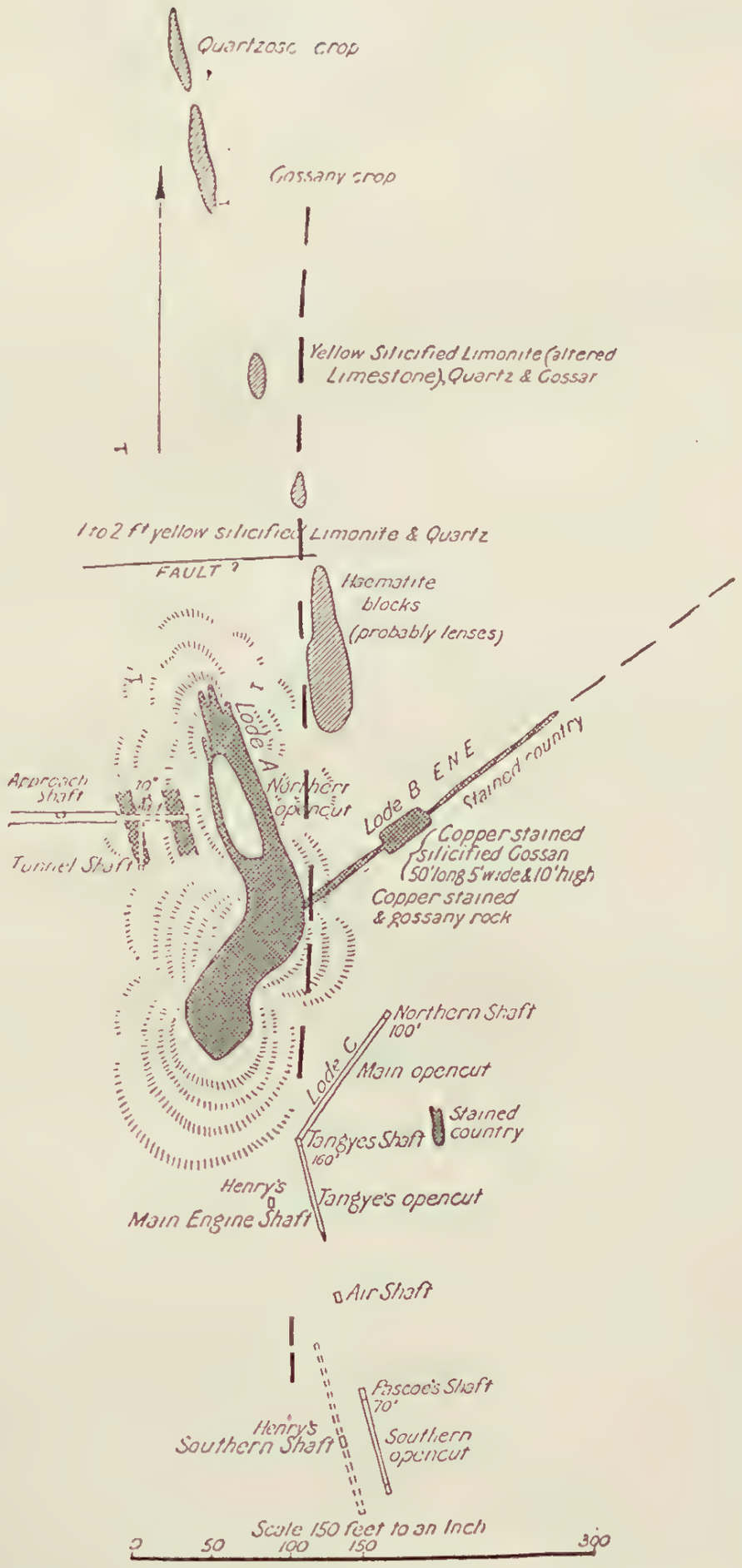
The southern opencut, a chain in length, also represents collapsed stopes south from Pascoe's shaft.

The adit, which is 15 ft. wide and 8 ft. high, was opened on the western side of the main crop, evidently with the idea of testing it beneath the surface. The approach is a chain in length, and the adit itself 40 ft. At 12 ft. from the mouth of the adit a drive runs southwards for 25 ft. to the Tunnel shaft.

The Approach shaft is an old one half-way along the approach to the adit on the northern side.

The vertical Tunnel shaft, 6 ft. by 3 ft., 25 ft. south of the adit, was left when 50 ft. deep by the former holders. The present management had at the time of my visit cleaned it out, and continued it to 57 ft. below the surface, and had begun a crosscut (12 ft.) to the west, at the 50 ft. level.

The Northern shaft, a chain to the south-east of the main ore body, and 3 ch. south-east of the adit, is 100 ft. deep, and is now inaccessible. There is understood to be at 70 ft. depth a short drive northwards, and one southwards to Tangye's shaft, above which the ore has been stoped to the surface.



SKETCH PLAN, OUTCROPS AND WORKINGS, GREAT AUSTRALIA.

Tangyo's underlie shaft (inaccessible), 1½ ch. south-south-west of the Northern, is 160 ft. deep, the main levels being at water-level (75 ft. below the surface), but there are believed to be shorter drives at a still greater depth. The old stopes to the south have now collapsed.

The underlie Air shaft is 1½ ch. south of Tangye's, but is inaccessible, and no particulars are available as to its depth.

Pascoe's underlie shaft, 1 ch. beyond the air shaft to the south, is 70 ft. deep. The old stopes, extending for a chain south of this shaft, have now fallen in forming an opencut.

Henry's old vertical shaft, to be known in future as the Main Engine shaft, lies ½ ch. south-south-west of Tangye's shaft. This was sunk a few feet below water level (70 ft.) by Henry, and under the present management had, when seen by me in January of this year, been cleaned out 15 ft., and cut down to 10 ft. by 4 ft. in the clear.

Henry's southern vertical shaft (inaccessible) 1½ ch. south-south-west of Pascoe's, is 80 ft. deep, and at the bottom there are levels 60 ft. north and 50 ft. south.

Output.

No records prior to 1884.

1885—253 tons ore, yielded	...	...	...	60 tons copper						
1886	...	...	...	...	...	...	...	200	,,	,,
1887	...	...	...	...	...	...	...	190	,,	,,

The Warden mentions that 1,340 and 1,010 tons of ore were raised during the years 1885 and 1887, but makes no reference to any output in 1886 and 1888. The total raised probably exceeded 3,000 tons.

The ore now at grass is stated to be 740 tons, and its average contents is, according to Messrs. Alex. Hill and Stewart, 13·12% copper.

The seconds from the opencut amount to 130 tons, averaging 8·8% copper.

Geology.

Country.—The country rock west of the workings dips westwards and consists of schist, that to the east dips east-south-east, and comprises highly altered sedimentaries, with lenses of spotted calcite. The spots in the calcite represent crinoid joints, and indicate its organic origin.

Lenses of limestone, 2 ch. in length and 6 ft. wide, have been worked in shallow quarries ¼ mile north of the mine. The rock consists, with the exception of a few bands, of pure crystalline grey marble. There are indistinct indications of crinoid joints, proving its sedimentary origin—as against secondary segregation from the country rock.

Besides the small crops* of hæmatite to the north of the main workings, referred to under the description of the Ore-bodies, the freehold includes a comparatively important crop at Pisa Hill, described elsewhere in this report.

There is a possibility of the strata between Mount Leviathan and Pisa Hill having been bent into a deep synclinal fold, and in that case the iron ore-bodies cropping on opposite sides may all occur in one stratum, though they will of course have no direct connection.

The association of hæmatite and sulphides is strong evidence in favour of the ore-bodies being genetically due to regional metamorphism, but there is some further evidence of extensive faulting at the Great Australia, allowing of the introduction of copper from deeper seated regions.

Ore deposits.—The main crop at the Great Australia consists of a great number of bunches of ferruginous ore, distributed through the country, but the bodies stoped may possibly be on lines of fault. In their present state an inspection cannot be made and my conclusions are therefore indefinite.

Mr. Jack first described lode B as on a line of fault, but it is not certain as to whether he also considered lode C to mark a fault. There is in fact a probability of the latter lying along the bedding of the country. Evidence of still another fault is available. This is an east and west crop 1 to 2 ft. thick, of silicified limonite, 2½ ch. north of the adit. It would thus appear that the main outcrop lies between two faults, and is intersected by a third. Further, the divergence in the general strike of the country east and west of the workings indicates that there is also a more extensive north and south fault to the east of the main crop. This is more likely than any of the others to have provided a passage for solutions which, on rising, passed out along the more shallow faults and along the bedding planes of the adjacent upended strata.

Ore-bodies.

The ore bodies are described below in the order of their importance:—

Main ore-body.—The main crops at the Great Australia are in a hillock, 5½ ch. in length and 3 ch. in greatest width, rising to 40 ft. above the adjacent plain. The greater part of the hillock is composed of silicified ironstone (really ferruginous secondary silica) and cupriferous slate, dipping 70° to the west-south-west. On the cap of the ridge there is only slightly silicified limonite stained with copper, and this is generally spoken of as the main crop (lode A of Mr. Jack). It may be taken as 3½ ch. in length, gradually fraying out within 1½ ch. north of the adit, and ½ ch. in width, though not sharply divided from the country alongside. It has the shape of a boomerang, being

* The attached plan shows wrongly a large lens north-east of the northern open-cut, there being instead probably a number of small lenses here.

sharply bent near the southern end. In the northern opencut no ore richer than 10% in copper can now be seen, but there is of course a possibility of rich bunches raising the average much above this.

In my opinion it will be found that the ore occurs in big lens-shaped masses here, and that when one pinches out one or more others will be found on sinking, crosscutting or driving. The ore bodies here seem to occur at no great intervals, presumably owing to the major and minor faults referred to under "Geology." At the present time it cannot be affirmed that the ore in sight is payable, but the probabilities warrant sinking to water-level at least, and then crosscutting and driving.

The approach to the adit exposes ferruginous altered slates, dipping westwards 70° and containing bunches of limonite, over a width of a chain.

The adit itself reveals two ore-bodies. The first, 12 to 15 ft., consists of gossan, with occasional bunches of copper ore; then across the drive to the south there is 15 ft. cupriferous and gossany altered quartz-bearing country rock, beyond which to the face is found dense limonite, with thin seams of malachite. There is no sign of fissuring, but even if there had been fissures one would not expect to find much evidence in such softened country as this. There can be no doubt that this gossan will be found to pass down into low-grade pyrite—containing perhaps 5% copper.

The approach shaft was sunk in copper-stained limonite; and there are about 60 tons of that ore stacked adjacent to it, but part of this may have come from the adit.

The tunnel shaft, at 56 ft. depth, passed out of a body of dense limonite in decomposed greenish country, with irregular bunches of cuprite-limonite ore up to a foot in diameter. The western crosscut proves the limonite body to be at least 12 ft. wide, and to have scattered through it grains and lumps of quartz, and besides to be slightly stained by malachite. The ore at the 50-ft. level is undoubtedly poor, but there is every probability of richer being found at water-level, below which sulphides may be expected in quantity. Only about 5 cwt. of ore, limonite rich in cuprite and malachite, had been paddocked.

The Central Ore-body.—Mr. Jack's lode B runs off north-east nearly at right angles to the main crop at the bend, and can be traced for 3 ch., chiefly as stains in the country. At a distance of a chain from the main crop it projects 10 ft. above the ground, and for over ½ ch. has a width of 5 ft. It is composed of silicified gossan, only slightly copper-stained. Mr. Jack states that lode B occurs on a line of fault, but I had no opportunity of verifying that observation.

The Southern Ore-body.—Mr. Jack's lode C, which is south of the main crop and converges, as indicated by the main open cut, towards lode B, may be either on a line of faulting or else on a bedding plane.

The main engine shaft is being sunk in the foot-wall (the eastern side) of an ore body, but some bunches of limonite containing cuprite have been obtained in cutting down the shaft. (Later, see "History.")

Eastern Ore-bodies.—Copper-stained country is found about a chain east of the southern workings, and on the flats to the north and north-east of the main crop numerous bodies of hæmatite outcrop as well as cherty yellow siliceous rock, quartz and slightly cupriferous gossan following the general strike of the western country. A gossan crop of some promise lies abut 5 ch. distant from the northern end of the main crop.

Conclusions.—From the descriptions given above, it will be seen that in the present state of the workings it is not possible to calculate even the probable amount of ore available here, and no estimate can be made of the average tenor of the ore. Nevertheless, it can be stated that the deposits are worthy of thorough trial, and the developments only now being undertaken with the idea of blocking out the deposits are in every way warranted.

No. 11 (M.F. 11).

Location, Etc.

Freehold No. 11 adjoins the township on the east and the A1 freehold on the north.

Its area is 80 ac. It is the property of the Queensland Exploration Company.

No outcrops can be seen here, owing to the covering of alluvium.

No. 12 (M.F. 12).

Location, Etc.

Freehold No. 12 lies between the township on the west, M.F. 19 on the east and M.F. 11 on the south.

Its area is 80 ac. It is now in the hands of the Queensland Exploration Company.

No outcrops can be seen here, the whole being a residual and alluvial flat.

No. 19 (M.F. 19).

Location, Etc.

Freehold No. 19 lies to the east of the township, from which it is separated by only M.Fs. Nos. 11 and 12.

Its area is 628 ac., and the greater part of it has now been cut up into residential allotments.

No ore-body has yet been found on this area, which comprises both residual and alluvial flats and stony ridges.

No. 13 (M.F. 13).

Location, Etc.

Freehold No. 13 touches M.F. 19 on the north-western corner and lies just north of the township of Cloncurry.

Its area is 80 ac. It is held by the Queensland Exploration Company.

Ore-bodies.

No outcrop was seen on this holding, though the Company's plan indicates a small "outcrop" near the northern boundary.

No. 14 (M.F. 14).

Location, Etc.

Freehold No. 14 lies 1½ mile north-north-east of the township.

Its area is 80 ac. The Queensland Exploration Company now holds this ground.

Literature.

For title of report, numbered as below, see Introduction.

(7) Mr. Rutherford speaks thus of freehold No. 14:

> Like the Wanderer's, it consists of low disconnected ridges of indurated sandstone, which can be followed for a distance of 300 yards in a north-east and south-west direction. The country in the neighbourhood consists of similar low ridges of metamorphosed sandstone lying on the schist, but the presence of iron and silica in the "outcrop" seems to have determined the deposition of copper along this line. I examined nine trenches along the ridge, which all showed the rock stained in places with green carbonate. Two shafts, one 30 ft. deep and the other 16 ft. deep, show nothing beyond what is seen in the trenches. No body of ore can be seen on the property, though rich nodules of red oxide can be broken off here and there from the outcrop. A heap at grass near the 30 ft. shaft might, if picked, yield 1 ton of good ore. This little bunch of ore occurring at the surface probably determined the position of the shaft.

Development.

The workings, which are in the south-western part of the freehold, comprise a shaft 35 ft. deep, three trenches at 1½ ch., 3½ ch., and 5 ch. to the south-west, and a pothole 10 ft. deep, 1½ ch. beyond. During the second half of the year 1907, four shallow shafts have been sunk by the Company.

Ore-bodies.

The workings are on a more or less cupriferous and ferruginous quartzose crop, striking generally north-east and south-west, between crushed quartzites and schists to the south-east and ferruginous quartzites and schists to the north-west. Towards the south-west the crop—nearly 20 ft. across—is very siliceous, and is poor in copper, but, iron oxide being abundant, an improvement may take place in depth. "Floaters" of native copper and cuprite have been found in the soil over a width of 50 ft. on the trenched part of the ground, but no defined body of ore has been located.

The north-eastern trench is in dense limonite with copper stains and impregnations of secondary sulphide, warranting further work here.

The main shaft was sunk on a band of silicified limonite in clayey gossan. All firsts have been removed, but there are at grass about 2 tons of seconds—siliceous limonite with stains of malachite and thin veins of cuprite—containing not more than 5% copper.

The manager has reported the results of the work done on this freehold during 1907 to be very disappointing, and prospecting was therefore abandoned in September.

Cave Canem (M.L. 456).

Location, Etc.

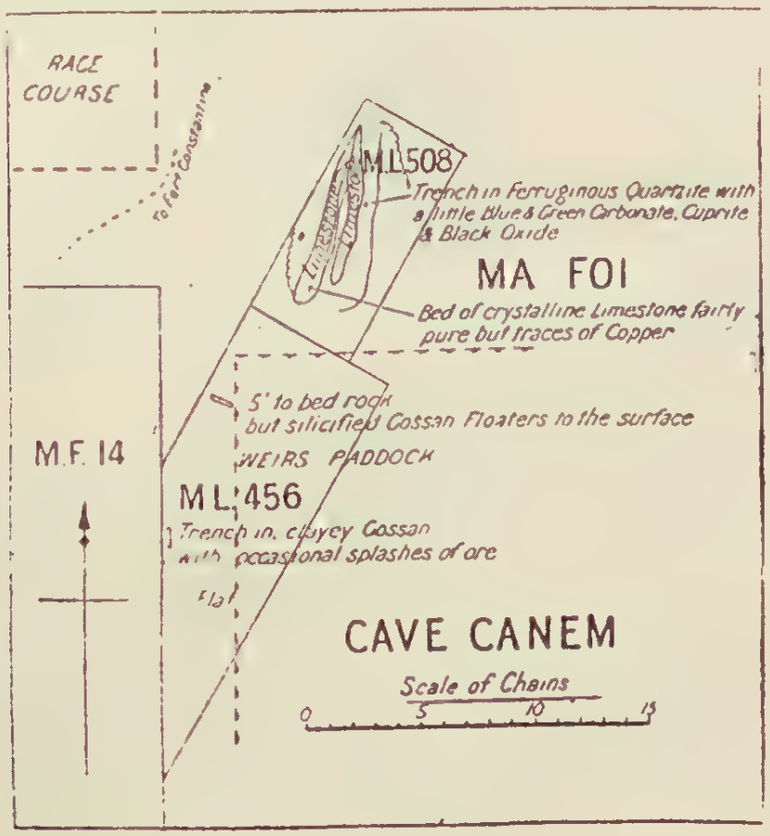
The Cave Canem adjoins M.F. 14 on the east, its distance north-east from the township being 1½ mile.

Its area is 9⅘ ac. Under exemption when visited.

Only two shallow trenches have been opened on this property, one half-way along the north-western boundary and the other 5 ch. south of the north-western corner.

Ore-bodies.

No ore-body has yet been exposed, practically the whole of the base being covered by alluvium. At the northern trench silicified gossan floaters were found from the surface to bedrock 5 ft. below. This siliceous rock is similar to that found in the vicinity of the Great Australia and other lodes in the district, and may generally be considered as replaced limestone.


RACE COURSE
M.L.508
Trench in Ferruginous Quartzite with a little Blue & Green Carbonate, Cuprite & Black Oxide
MA FOI
Bed of crystalline Limestone fairly pure but traces of Copper
5' to bed rock but silicified Gossan Floaters to the surface
WEIRS PADDOCK
M.F. 14
M.L. 456
Trench in clayey Gossan with occasional splashes of ore
CAVE CANEM
Scale of Chains
0
5
10
15

In the southern trench can be seen a clayey gossan, with occasional splashes of copper ore as well as the siliceous rock. Further trenching is therefore warranted here.

This lease would seem, from the evidence available on the Ma Foi, to be on a calcareous zone, where precipitation of copper ores is likely to have taken place.

Ma Foi (M.L. 508).

Location, Etc.

The Ma Foi adjoins the Cave Canem on the north-east.

Its area is 5 ac. Under exemption when visited.

There is one shallow pit on the western boundary, and a trench near the centre of the lease.

Ore-bodies.

No ore-bodies have yet been found here, but the geology is interesting.

A belt, 1 ch. wide, of fairly pure crystalline limestone, with traces of copper, runs for 5 ch. north-north-eastwards along the north-western boundary of the lease, and is overlapped by a second thinner bed, 7 ch. long, reaching within 1 ch. of the northern corner peg. To the east of the limestones, ferruginous quartzites have been trenched and shown to be in parts gossany and stained by malachite and azurite, while vugs are lined with quartz crystals, coated with black oxide.

There is no sign of any quantity of even low-grade ore here, though the conditions are not unfavourable for deposition.

No. 4 (M.F. 4).

Location, Etc.

Freehold No. 4 lies 2 miles east-north-east of the township.

Its area is 80 ac. It is held by the Queensland Exploration Company.

No ore-bodies have been found on this freehold.

No. 3 (M.F. 3).

Location, Etc.

Freehold No. 3 is 2½ miles east-south-east of the township.

Its area is 80 ac. The Queensland Exploration Company now holds the freehold.

An unsuccessful search was made for the old workings here, which comprise, it is believed, two shafts.

ORE-BODIES.

The only ore seen was hæmatite and a little dense limonite. The main crop, which runs north and south along the summit of a ridge, is several chains long, and in one place is probably 40 ft. wide. No copper ore was seen, but other iron-bearing crops are visible on a line to the east of the northern end of the main crop.

It is unlikely that any considerable body of copper ore is to be found here.

Lady Mina (M.L. 552).

Mgr., Miller.

LOCATION, ETC.

The Lady Mina is 30 ch. south-east of M.F. 3 and 3 miles east of the township.

Its area is 5 ac. This is understood to be the property of the firm of Graham and Matheson.

DEVELOPMENT.

The workings comprise a shaft 56 ft. deep (Jan., 1907), and an opencut running 35 ft. to the north-west from the shaft, which is in the southern corner of the lease.

OUTPUT.

1906 ... 3 tons.

ORE-BODIES.

In the opencut can be seen a well defined footwall, dipping about 75° to the north-east, but all ore has been removed. The ore can be traced on the surface for 20 ft. south-east of the shaft.

Both cut and shaft have proved a formation, averaging 2 ft. in width, in which copper ore (malachite and chalcocite) occurs as irregularly shaped masses, and quartz as sheets on the footwall. Sulphides were reported in the Press to have been struck in May, 1907.

There are 5 tons of ore bagged, besides 4 tons of firsts (40% copper) and 1½ ton of seconds (25%) paddocked. The rejected, very siliceous, thirds amount to only 2 tons.

Mata (M.L. 692).

Mgr., Willmer.

LOCATION, ETC.

The Mata, embracing the Little Duchess, adjoins the A1 freehold on the east. It is about 1 mile from the Cloncurry post office.

Its area is 24 ac.

OUTPUT.

1904 ... 7 tons shipped, carrying 31% copper.
7 ,, ,,

No. 2 (M.F. 2).

Location, Etc.

Freehold No. 2 adjoins the A1 freehold at the south-western corner, and is traversed by the main anabranch of the Cloncurry River.

Its area is 160 ac.

It is held by the Queensland Exploration Company.

Ore-bodies.

The ground has been secured presumably to catch the continuation of the Contra lode of the A1 freehold, but, being covered by sandy alluvium, no outcrops have been found.

No. 19 (M.F. 19).

Location, Etc.

The second Freehold No. 19 is located on the anabranch of the Cloncurry River at the south-western corner of the township.

Its area is 19 ac.

Ore-bodies.

The holding, which was not inspected, is on the flood plan of the Cloncurry, and no outcrops were expected, but the company's plan shows a short one running north-north-eastwards. The manager reported in July, 1907, that this crop had been exposed over a distance of 262 ft., and proved to be about 6 in. wide; later he sank a shaft 16 ft., the vein, consisting of "bornite and chalcopyrite, in a specular iron matrix," being about 5 in. wide in a formation 2 ft. wide.

No. 10 (M.F. 10).

Location, Etc.

Freehold No. 10 is situated at the junction of Chinaman Creek with the Cloncurry River, and is 1½ mile west-south-west of the township.

Its area is 125 ac. The freehold is now the property of the Queensland Exploration Company.

Ore-bodies.

The freehold lies to the east of the main mass of Mount Leviathan, but includes the north-eastern extremity of the iron ore deposit.

The company's plans indicate a small east and west "outcrop of peacock copper" on the eastern side, which, however, was not seen by me. This crop has been sunk on since my visit. At a depth of 25 ft., "the ore-body has opened out to about 3 ft. . . . with 5 in. of good ore on one side and 8 in. on the other. This would average about 20 per cent. copper." In September, at 34 ft. depth, the formation occupied the whole width of the shaft, there being 6 in. of good ore on each side. At about 40 ft. depth much water was struck. The shaft at 37 ft. below the surface shows 2 ft. of 20% ore at the northern end, and 8 in. at the southern. Drives were carried northwards on 6 to 18 in. good ore in a 4-ft. formation and southwards in poor formation.

MORRIS CREEK.

The ore-bodies here examined trend generally east and west, as at Duck Creek, in contradistinction to those of the rest of the field, which run north and south. The crushing of the country, however, has been far less intense than at Duck Creek.

SERPENT HILL GROUP.

This group comprises the five contiguous freeholds—Nos. 5, 6, 7, 8, and 9—lying 6 miles west-south-west of Cloncurry.

The holdings were deserted at the time of my visit, and, there being some doubt as to their exact location, no attempt was made by me to find them. They have since been re-marked, and have now passed into the hands of the Queensland Exploration Company.

The freeholds are each 160 ac. in extent, and they lie on a north-west and south-east line, being in contact only at opposite corners.

Nos. 5, 6, and 8 are reported to include no outcrops. Mr. Rutherford remarks, "It is difficult to understand why such a large area—800 acres—was taken up in this district. . . . as I failed to see any indications that payable ore would be found on these freeholds."

Serpent Hill No. 7 (M.F. 7).

LOCATION, ETC.

No. 7 is at the south-eastern extremity of the group, and lies 4½ miles south-west of Cloncurry.

Its area is 160 ac.

LITERATURE.

For title of report, numbered as below, see Introduction.

(7) Mr. Rutherford has written—

No. 7, the most southern of the group, encloses a siliceous limestone prominence 200 ft. long and 40 ft. high. This limestone is stained with carbonate, and carries some nodules of red oxide of copper associated with iron. Immediately beyond the limestone to the north, lying in flat country, is a band of vitreous ferruginous quartzite. Two trenches across this band both show ferruginous quartzite.

Serpent Hill No. 9 (M.F. 9).

LOCATION, ETC.

No. 9 is at the north-western end of the line of freeholds, and is 5½ miles west of Cloncurry.

Its area is 160 ac.

LITERATURE.

For title of report, numbered as below, see Introduction.

(7) Mr. Rutherford wrote of No. 9—

This is taken up to include a quartzite hill, which gives its name to the group. Several shallow trenches have been cut in an erratic manner at the base of the hill in barren rock. The summit of the hill, however, is in places freely stained with carbonate. A trench 20 ft. long across the strata shows that these stains are confined to the surface. Some good boulders of malachite have been shed from the hill, and can be picked up on the surface.

Chum (M.C. 329).

Mgr., Davis.

Location, Etc.

The Chum is 7 miles west-north-west from Mount Leviathan and 2 miles east from Butcher's Creek. There has been some doubt as to whether this lease is located on a freehold.

Its area is 600 ft. × 350 ft. It was exempt when visited.

Development.

The workings comprise only one shaft, 15 ft. deep (10 ft. long and 6 ft. wide), and two potholes, 5 and 4 ft. deep respectively, 10 and 20 ft. east of the shaft. No work has been done here for some time .

Output.

1906 ... 3½ tons of ore shipped.

Ore-body.

The country here is stratified quartzite, and little can be made out as to the strike of the deposits. In the shaft the body appears to strike north-north-east dipping easterly, but the potholes are on an east-by-south line, and in the first cupriferous gossan is exposed, while in the second gossan can also be seen. A small patch of oxides crops 1½ ch. west of the shaft. These, however, appear to be separate patches, and a chain to the east only iron-stained quartzites, similar to the country to the south, can be seen. The quartzites crop within 30 ft. south of the shaft, and the lode can therefore have no extent in this direction, while it is likely to prove bunchy in form.

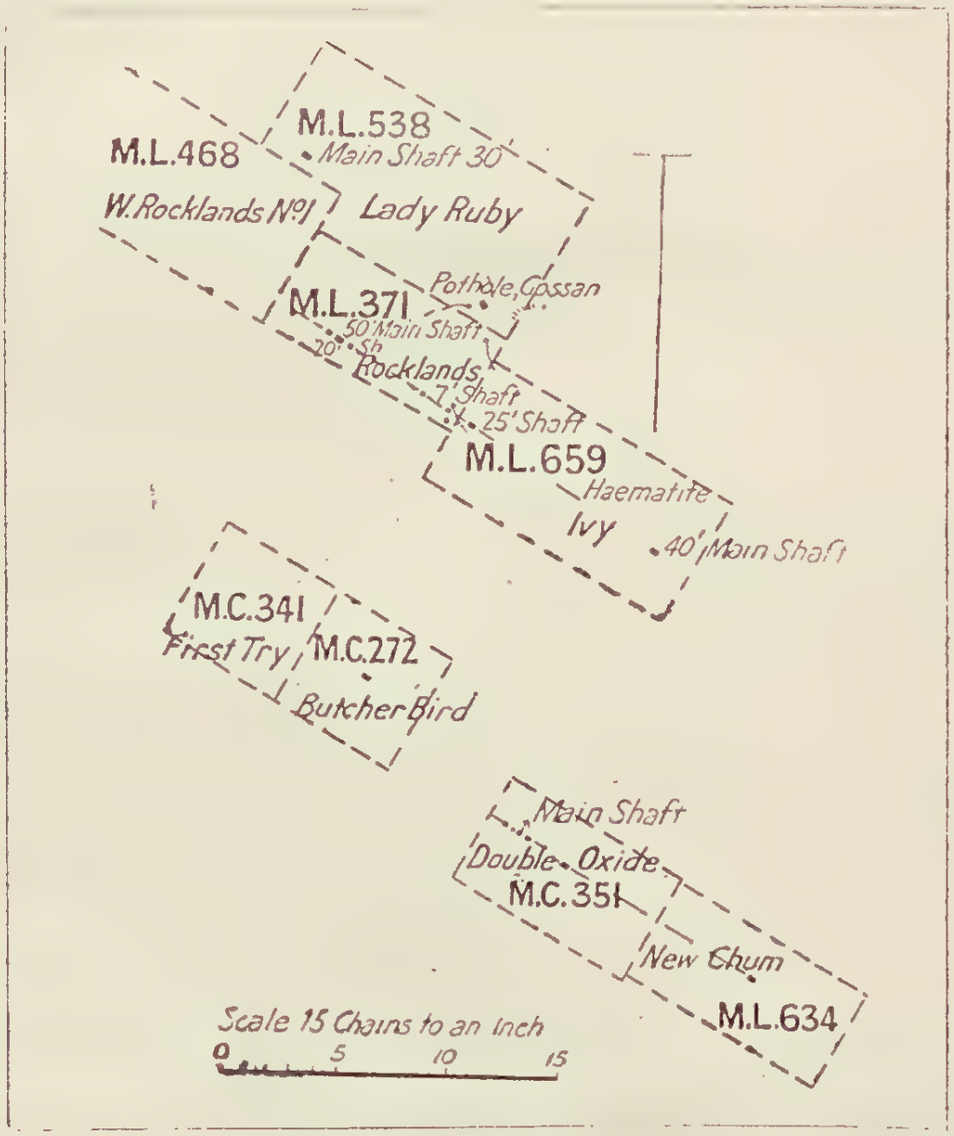
Over the whole length of the shaft masses of gossan and bunches of chalcocite-limonite ore, both with malachite and the former with some cuprite, occur between horses of country rock. Barren rock, cupriferous and ferruginous clay, and ore (varying between 10% and 40%, but averaging 20% copper) may be taken as present in equal quantities—the northern side of the shaft being rather poorer in copper, though richer in iron, than the southern. The western end of the shaft shows a face—perhaps a wall of the lode—dipping 10 in 1 to the east.

About 3 tons of lump ore, as raised from the shaft and lying at the brace, consists of siliceous limonite with tile ore and malachite, and may run 20% copper. The appearance of this ore is promising for the finding of richer ore beneath. The 1½ ton of firsts near the shaft comprise siliceous limonite, tile ore, crystalline cuprite in banded aggregates, acicular malachite, and dense chalcocite, and should contain at least 20% copper—the percentage depending chiefly on the composition of the tile ore. Besides this there are 6 tons bagged on the ground.

Thus, no continuous body of ore has been proved here, but the outcrops should receive thorough prospecting.

ROCKLANDS GROUP.

This group lies between Butcher's and Morris Creeks, 9 miles west of Cloncurry. Little work was going on here at the end of last year.



Double Oxide (M.C. 351).

Mgr., Neal.

Location, Etc.

The Double Oxide is 9 miles west-by-north of Cloncurry in open rolling gidia country.

Its area is 600 ft. × 350 ft.; and it includes the Magpie and Oxide claims.

Idle when visited.

Development.

Besides a few potholes, there are here four shafts. The main underlie shaft (5 in 1), 2 ch. from the western boundary, is 25 ft. deep, and the ground has been stoped out from it for 10 ft. to the east. A new shaft, 20 ft. to the east of this, is 20 ft. deep. The third, 15 ft. deep, is 2 ch. to the east-south-east.

OUTPUT.

1901	... 8	tons (Magpie)
1906	... 12½	,, (Oxide)
—	... 8	,, (Roberts and party)
Total	... 28½	,,

ORE-BODIES.

The New Chum line, which appears to be parallel to and about 10 ft. south of the Oxide, can be traced along the surface by crops of quartz and gossan.

Very little ore can have been raised from the eastern shaft, which is on the above line.

The Oxide, striking east 20° south, makes little show at the surface, but at the main shaft a formation—altered schist—rich in copper in parts but averaging only 10% in the present face, has been exposed over a width of 4 ft., and no hanging-wall has yet been reached. The formation pinches to 2 ft. 6 in. in the eastern end of the stope, and the average content there is 15% copper. Flat clay floors, some of them 6 in. thick, cross the formation at intervals of from 6 in. to 2 ft. Malachite is the chief copper mineral in the limonite, but chrysocolla is more abundant in the altered schist. The firsts at grass, amounting to 5 tons, are rather siliceous limonite with veins and bunches of cuprite; and some 16 tons have been shipped from here. The mullock tip should carry at least 5% copper.

The country rock at the second shaft is a quartz-veined argillaceous quartzite, but the ore here carries little quartz. The 10 tons of ore at the brace have not yet been sorted. It is chiefly limonite containing malachite, chrysocolla, and cuprite, and carrying about 10% copper.

New Chum (M.L. 634).

Mgr., Davis.

LOCATION, ETC.

The New Chum adjoins the Double Oxide on the east.

Its area is 5 ac.

The only excavations beyond a few shallow trenches is the shaft, 20 ft. deep, near the centre of the claim.

ORE-BODY.

The ore-body can be traced westwards to the eastern shaft in the adjoining claim, the line being parallel to, but about 10 ft. south of, the main Double Oxide line.

The shaft was sunk in thin bedded slates, with bunches of silicified limonite; and there is at grass about 1 cwt of quartz-bearing limonite, containing a fair proportion of cuprite. The cuprite is crystalline, and in most unsymmetrical forms, but is evenly, if thinly, coated with vitreous greenish chrysocolla. This ore has some resemblance to that at the Great Australia.

Butcher Bird (M.C. 272).

Mgr., Roberts.

LOCATION, ETC.

The Butcher Bird shaft lies about 10 ch. west 35° north of the Double Oxide.

Its area is 600 × 350 ft.

One shaft, 14 ft. deep, and a pothole, 7 ft. deep, are all the workings.

OUTPUT.

1905 ... 8 tons.

ORE-BODY.

The shaft has been sunk in rotten formation—ferruginous kaolin with lumps of limonite, showing some malachite towards the bottom. Nothing definite has yet been proved here, but sinking should be continued.

This does not seem to be a continuation of the Double Oxide as its strike (east-south-east) would carry it to the north of the main workings on the latter.

The pothole to the north-west of the shaft is in iron-stained quartz not worth further testing.

First Try (Extended M.C. 341).

Mgr., Melhouse.

LOCATION, ETC.

The First Try adjoins the Butcher Bird on the west.

Its area is 400 × 350 ft.

Only four potholes have been opened here, the deepest 4 ft. down. No lode has yet been found.

Cherry (M.L. 670).

Mgr., Connell.

LOCATION, ETC.

The Cherry is 1½ mile south of the Rocklands.

It area is 10 ac. It was not inspected by me.

Mount Abundance (M.L. ?).

Mgr., Connell.

LOCATION, ETC.

Mount Abundance is 7 miles west of Cloncurry.

Its area is 10 ac. It was not inspected.

OUTPUT.

1906 ... $\frac{14}{20}$ ton.

Rocklands (M.L. 371).

Mgr., Hockings.

Location, Etc.

The Rocklands is less than ½ mile south-east of Morris Creek, and 9½ miles west-by-north from Cloncurry, the distance by road being 10 miles.

Its area is 5 ac. The lease was exempt when inspected at the end of 1906, and the mine had been idle for some time.

Development.

The workings run nearly the whole length of the lease, but are all shallow. The eastern shaft (*a*), 10 ft. deep, is ½ ch. from the south-eastern corner; 5 ft. west of it is a trench, 10 ft. long; 1 ch. beyond is a shaft (*b*), 7 ft. deep. Then 4 ch. further west is a shaft (*c*), 20 ft. deep (flooded); ½ ch. beyond is another (*d*), 15 ft. deep (filled in), at which some stoping has been done; and 10 ft. further west is the main shaft (*e*), 50 ft. deep (inaccessible). A filled-in trench lies 10 ft. west of the main shaft, and 15 ft. beyond it is another shaft (*f*) 15 ft. deep.

Output.

1906 ... 22½ tons.

Ore-bodies.

The line of strike is west 32° north, and the dip is 5 in 1 northwards, as shown by the workings. The country rock is a black slate weathering to a brown tint and bleached almost white near the ore-body, especially in the western shafts. Very little can be seen of the ore-body, which, however, can nowhere have exceeded 2 ft. in thickness. Practically all rich ore raised has been shipped, and it cannot be said, without further development, that there is any in sight.

A few hundredweights of very siliceous fine-grained carbonate ore (25% copper) is at grass at shaft (*a*); and at shaft (*b*) there are a few pounds of carbonate and oxide ore. Only a small heap of seconds—country carrying 1% copper—now remains at shaft (*c*).

At the main shaft (*e*) there are now only 2 cwt. of firsts (30% copper) at grass—chalcocite with malachite stains and coated with kaolin. The cellular gossany seconds at grass amount to 10 tons, and should average 5%.

In the western shaft (*f*) the formation near the surface is 1 ft. wide, and a bunch of rich ore was gouged out here.

Rocklands No. 1 East (M.L. 659).

Mgr., Lyons.

Location, Etc.

This, which is also known as the Ivy, adjoins Rocklands on the east.

Its area is 8 ac. Exempt when inspected.

DEVELOPMENT.

The main shaft at the eastern end of the lease is 40 ft. deep; and water is now standing at about 35 ft. below the surface. A stope runs back 10 ft. on the northern side of the shaft.

Another shaft, 25 ft. deep, and a cutting are on the north-western boundary.

OUTPUT.

		18	tons (western workings)
		3	,,
		3	,, rubbly surface 28½%
		7	,, no returns to hand
Total	...	31	,,

ORE-BODIES.

The western shaft and cutting are on the Rocklands line. The country is softened slate, and the ore, striking east 35° south, crops as silicified limonite, with malachite and tile ore. One bunch here yielded 18 tons of pay ore.

Some dense hæmatite indicative of regional metamorphism crops on the line of strike between these workings and the main shaft.

In the main shaft a formation, 3 ft. wide, of malachite-stained softened slate with siliceous cellular gossan, dipping steeply northwards, has been struck. The gossan is a promising feature, as far as improvement in depth is concerned. The hanging-wall country is much slickensided internally owing to lateral crushing, as proved by the horizontal striæ. The ore at grass, 4 tons, is chiefly earthy carbonate with traces of glance and rather much quartz, but is expected to yield 30% copper.

Rocklands No. 1 West (M.L. 468).

Mgr., Hockings.

LOCATION, ETC.

This adjoins the Rocklands on the west.

Its area is 10 ac. The ground was deserted in December, 1906, and was not inspected, as no work had been done.

Lady Ruby (M.L. 538).

Mgr., McCall.

LOCATION, ETC.

The Lady Ruby adjoins the Rocklands and Rocklands No. 1 West on the north.

Its area is 10 ac. Exempt and deserted.

A pothole in the southern corner and an inaccessible shaft, 30 ft. deep, in the western corner, are the only workings.

ORE-BODIES.

The southern pothole is on gossan, but has not yet struck ore.

The main shaft is sunk just to the south of a quartzite crop in decomposed slates dipping northwards about 4 in 1.

The only ore at the shaft is about 1 cwt. of copper-stained country rock, in which can be seen small seams and beads of cuprite.

Nothing is visible here to warrant further work.

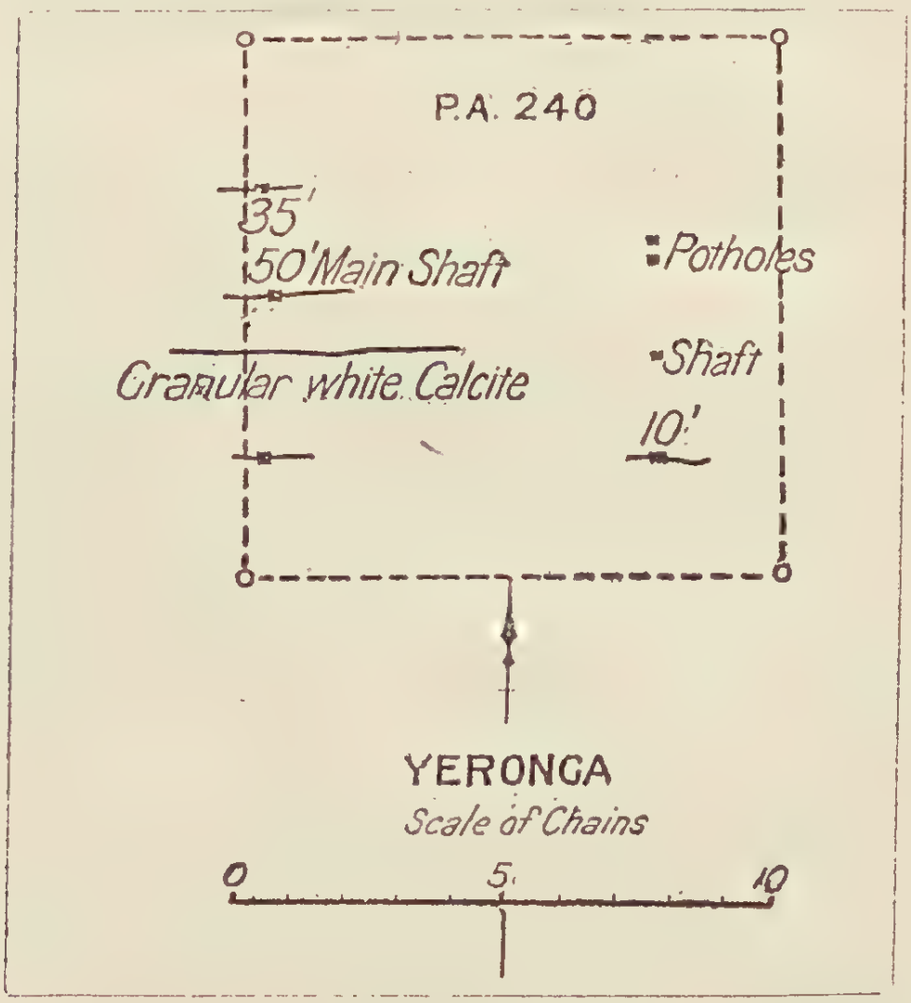
Yeronga (P.A. 240).

Mgr., Hockings.

LOCATION, ETC.

The Yeronga is ¾ mile north-west of the Rocklands, ¼ mile over Morris Creek.

Its area is 10 ac.



DEVELOPMENT.

The main shaft, 50 ft. deep, with 8 ft. standing water, is near the middle of the western boundary, has a stope running back for 10 ft to the east, and drives 12 ft. east and west at the bottom and 20 ft. depth respectively; a second shaft, 35 ft. deep, lies 2 ch. to the north (inaccessible); a third lies 7 ch. to the east; and a fourth, 10 ft. deep, 7 ch. to the east-south-east.

Output.

Total of 30 tons shipped averaging 34% copper.
5 ,, 27% ,,
—
35 ,,

Ore-bodies.

There are here at least three east and west striking lines, besides which, a chain south of the main shaft, is a defined crop of granular white calcite. Earthy calcareous sinter, derived from the country rock, is also very abundant in all the ore raised here. The occurrence in the main shaft is promising, but no quantity of ore has yet been proved.

The ore-body, in which is the main shaft, dips 10 in 1 to the south. It is 1 ft. wide at the surface, but, in the western drive, there is quite 2 ft. of limonite and very calcareous ore. The country there is softened slate, without sign of movement. The ore at grass, about 1 ton, is limonite with much chalcopyrite, considerable malachite, and some chrysocolla.

The south-eastern shaft is in decomposed calcareous slate, in which a little ore has been got. Fragments of ore can also be got along the line of strike, and about 7 ch. to the west was found a patch which yielded 3 tons of 33% ore—chalcopyrite and chalcocite.

The northern shaft is in very limy decomposed country, in which the ore occurs as boulders near the surface, but at the bottom there is a defined formation 3 ft. wide. The seconds, about 1 ton, are limonite with chalcopyrite, pyrite, chrysocolla, and carbonates. Some quartz cemented by limonite, jasperoid, and chalcopyrite is coming in in the shaft bottom. The firsts, of which 5 tons, assaying 27% copper, have been shipped, are reported to have contained some good cuprite.

The eastern shaft and potholes are in gossany copper-stained country.

Fairfield (M.L. 680).

Mgr., Hockings.

Location, Etc.

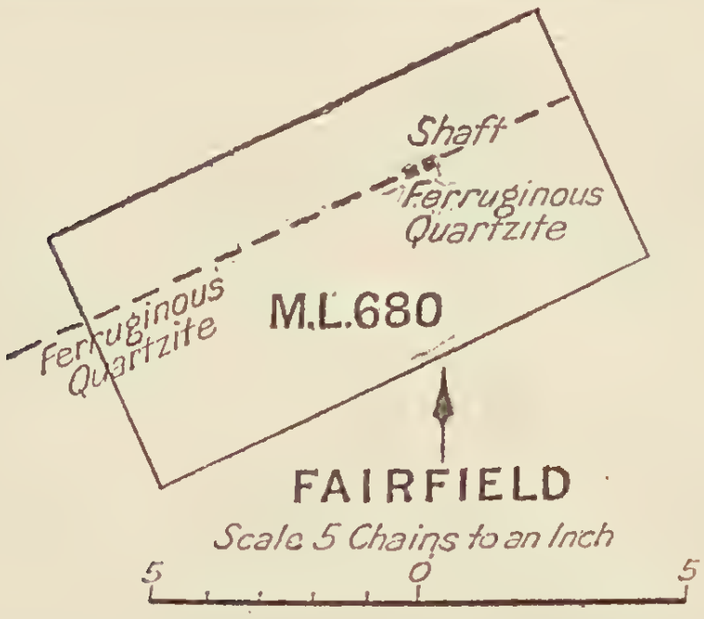
The Fairfield lies 1½ mile north-north-west of the Rocklands, and 10 miles west-north-west of Cloncurry.

Its area is 5 ac. The lease was deserted at time of inspection. This ground was formerly held as the Waimakaori, and as the Darra.

Development.

The old eastern shaft (*a*), 10 ft. deep and flooded, is 3 ch. south-west of the northern corner of the lease; another old shaft, 25 ft. deep

and underlying 10 in 1 to the south, lies 30 ft. to the west; and the new shaft, 15 ft. deep, is 30 ft. south-west of this.



OUTPUT.

2 tons shipped 32% copper.
3 „

ORE-BODIES.

The Fairfield crop at the new shaft is 10 ft. wide, and consists of silicified limonite and gossan. It pinches out about 20 ft. west of the shaft, but crops again in several places beyond. Eastwards also it thins out, but there is here a band of gossan on the northern side, in which the old shafts were sunk. The crop strikes east-north-east, and the dip is to the south-south-east.

The two old shafts appear to be on one shoot, of which the silicified limonite forms the hanging-wall. In the shaft (*b*) a formation, 1 to 2 ft. wide, carrying bunches of ore, is exposed.

The new shaft is being sunk in kaolinised slate above the silicified limonite. A nearly vertical lens of ore was met in this shaft, and there is now paddocked about 2 tons of siliceous chalcocite-malachite ore expected to yield 30% copper.

Nothing of any value has yet been exposed here, but there is a possibility of the silicified limonite blows overlying sulphides, and the amount of silica may decrease with depth.

Unnamed (M.F. 16).

LOCATION, ETC.

This freehold is south of Morris Creek, 9 miles west-south-west of Cloncurry.

Its area is 160 ac. Not inspected.

CAMERON RIVER.

The Cameron River mines are of relatively little importance. The Federal is included here, as is the usual custom, though it is really within the Corella drainage area. Numbers of claims have been, or are, in existence on the northern side of the Cameron Valley, but their location had not been sufficiently fixed for a visit to be paid to them.

MOUNT LLOYD GROUP.

The Mount Lloyd Group is located in the valley of the Cameron River. It comprises, besides those described below, the Mount Lloyd No. 1 North (M.L. 497), Mount Lloyd No. 2 South (M.L. 517), and Mount Lloyd No. 3 South (M.L. 545), on which no work has been done, and the Saint Patrick (M.L. 498), in the southern part of which is a shaft, not seen by me.

Mount Lloyd (M.L. 446).

Mgr., Thompson.

LOCATION, ETC.

Mount Lloyd lies 31 miles west of Cloncurry and about 2 miles south-east of the West Leichhardt telegraph line.

The leases are on a north-north-west running razor-back near the centre of a wide flat-bottomed valley, bounded by a rounded range to the west and a fairly-level topped range to the east.

Its area is 30 ac. It is understood to have now been abandoned, the exploratory work having been carried out under option by the North Queensland Exploration Company.

DEVELOPMENT.

An opencut 25 ft. long, 10 ft. wide, and 7 ft. deep, has been made on the ridgetop near the centre of the lease. In the trench is a shaft 50 ft. deep, from which the upper ladders had been removed, rendering it inaccessible. Several other small trenches have been made to the south-east, along the hillside.

ORE-BODIES.

A crop of quartzite runs north-north-westwards along the crown of the ridge and dips steeply west-south-westwards. It has been proved by the cut to carry not 1% of copper and very little iron oxide —even in the richest part. The tip at the shaft proves that the sinking was in silicified schist with stains of malachite in places.

Mount Lloyd No. 1 South (M.L. 499).

LOCATION, ETC.

This adjoins the Mount Lloyd on the south.

Its area is 5 ac.

Two cuts have been opened on this lease, about $\frac{1}{4}$ mile south-south-east of the Mount Lloyd shaft.

ORE-BODIES.

The cuts expose only small bunches of ore in quartzite.

EUSTON GROUP.

This group is on the lower portion of the Cameron River, near the bottom crossing of the West Leichhardt telegraph line.

Cameronian (M.C. 196).

Mgr., St. Onge.

LOCATION, ETC.

The Cameronian lies 27 miles west-north-west of Cloncurry, and about a mile north-west of the West Leichhardt telegraph line.

Its area is 400 ft. by 350 ft.

One hole has been sunk 7 ft.

OUTPUT.

Several tons of ore are reported to have been shipped.

ORE-BODIES.

Bunches of cupriferous gossan are found to occur in slates over a width of 30 ft., at the southern end of a low ridge. The hole is on a copper-bearing lenticular body 2 ft. to 2 ft. 6 in. wide, which can be traced for about a chain to the north-east. There are at grass a few hundredweights of seconds, consisting of quartz-bearing limonite, with some chalcopyrite, chrysocolla, and malachite.

Unnamed (M.C.).

Mgr., Lidster.

LOCATION, ETC.

This is about ¾ mile north of the Cameronian.

A pothole, just begun, was 4 ft. deep when visited.

ORE-BODIES.

The pothole is in earthy limestone and sintry slates containing bunches of limonite-malachite-chalcopyrite ore. About 1 ton of ore is paddocked, and consists in great part of limonite, with original chalcopyrite and stains and coatings of malachite. It is likely to yield 20% copper.

FEDERAL GROUP.

The group comprises only one lease.

Federal (R.C. 52).

Mgr., Brassington.

LOCATION, ETC.

The Federal lies 20 miles west-north-west of Cloncurry. The Argylla road passes the mine, about 3 miles west of the Corella River.

The country here is open and rolling with gravelly red soil, timbered sparsely with mountain gum and clothed with spinifex.

Its area is 80 ac. The mine was deserted when visited by me, but has since been taken over by the Federal Reward Copper Company, Limited.

Development.

The main workings appeared to have been deserted for some time, and most of them have collapsed. They comprise, beginning at the southern end: an open cut (*a*), 35 ft. long and 15 ft. wide, now full of water; a trench (*b*), 10 ft. long, 10 ft. to the north of the cut; two potholes (*c* and *d*), 5 ft. deep and 15 ft. apart, 35 and 50 ft. north of the last; a filled-in cut (*e*), 10 ft. long, 20 ft. beyond; a flooded trench (*f*), 10 ft. long, with a 10-ft. hole at one end, 5 ft. to the north; and a main shaft (*g*), 30 ft. deep, with open cuts or fallen-in stopes for 15 ft. north and 10 ft. south at 15 ft. beyond the last. At 5 ch. north-north-east of the main shaft is the shaft (*h*) last worked, which is about 15 ft. deep; and about 1½ ch. to the south-east of it are a few shallow trenches.

Output.

1904	...	85 tons	shipped.
1905	...	71 ,,	,,
1906	...	12 ,,	,,
	...	12 ,,	,, *
Total	...	180 ,,	,,

Ore-bodies.

The southernmost cut (*a*), being full of water, reveals little. There are about 5 tons of seconds alongside it—siliceous ore containing malachite and nodular radiating azurite, and likely to run over 15% copper. The whole of the mullock tip should yield at least 1% copper.

In the northern end of the trench (*b*) can be seen 18 in. of cupriferous quartzite and formation. The 1 ton of firsts (quartz and malachite) at grass probably carries 20% copper; and the ½ ton of seconds may yield 10% copper.

The first of the potholes is on the western side of a quartzite crop.

The cut (*e*) is on a slight bend in the quartzite crop.

The whole formation in the main shaft and stopes probably averaged 12 to 18 in. in width, but at the northern end the ore occurs simply as stainings on joints in the slates, but presumably bunches have been found by following these joints, and there is indication of one in the footwall. Dog-tooth quartz is plentiful, and some fairly rich fine-grained malachite, nodular azurite, and limonite with disseminated malachite, are to be seen here.

The firsts, of which there were 2 tons at grass, are very siliceous, encrusted by malachite and contain nodules of azurite. The seconds

* By Hockings and Brassington; source doubtful.

at grass amount to 4 tons; they are very siliceous, but are gossany and carry perhaps 5% copper chiefly as carbonate. Further there are about 4 tons of unpicked ore paddocked, consisting of limonite with disseminated malachite and bunches of azurite, which must have come from bodies up to 12 in. in width.

The country rock is kaolinised schistose slate passing near the lode into greenish chloritic schist, in which the ore-bodies occur on a general north and south line, dipping about 5 in 1 to the west.

The new shaft (*h*) is on a 2-ft. band of country (slaty schist with north and south strike), carrying malachite and azurite. The strike is north and south and the dip is steep to the west. There was 1 cwt. of firsts (limonite with traces of chalcopyrite and rich in malachite and azurite) of 30% copper grade; and a few hundredweights of 20% seconds, at grass.

The easternmost trenches prove only that the schistosity of the country here trends north-eastwards.

The workings have been too long idle for much to be learnt as to the nature of the ore-bodies, further than that they are composite lodes—with comparatively small linear extent. The indications warrant further opening up to test whether an improvement takes place in depth.

ARGYLLA CREEK.

The Princess East, South, and North are three leases (Nos. 594, 593 and 592), each 10 ac. in area, of which no particulars are to hand, beyond that they lie 3½ miles south-east of the Argylla freehold. The Megaphone, a lease (No. 541) of 10 ac. is understood to lie 3 miles south of the freehold.

ARGYLLA GROUP.

The group comprises a freehold and a few leases in its vicinity. The Argylla North (M.L. 539), West (M.L. 536), and South (M.L. 540), after being abandoned, were taken up again by the West Cloncurry Copper Company, Limited, in areas of 20 ac. adjoining the freehold.

Argylla (M.F. 3073).

Location, Etc.

The freehold is situated on the eastern side of a branch of the Argylla valley, 13 miles east of the West Leichhardt Telegraph Station and 40 miles west of Cloncurry.

Its area is 40 ac. The Argylla is now held by the Queensland Copper Freeholds, Limited. My visit was made with the assistance of and in company with, the Warden (Mr. Linedale), on whose account the examination had to be very hurriedly performed. From what was seen, however, it was not considered worth while to revisit the locality even if it had been possible without considerable expense, more especially as the ground was deserted.

Literature.

(2) Mr. Jack's report is as follows:

The Argylla Mine is a wide belt of copper-bearing country running north-north-west to south-south-east. The dominant feature of the belt is a wide reef of rather open and friable quartz, standing up as a crest on a hill top for about three-eighths of a mile, and nearly 80 ft. above the general level of the slate country.

The western side of the quartz reef at its north end is stained with carbonate of copper, its numerous caverns being conspicuous from a long distance owing to their bright green colouring. Traced to the south the whole is seen to be a belt of copper lodes, generally running parallel to the dominant quartz reef, but sometimes running out obliquely from it, and abutting against parallel veins of quartz. We saw a good deal of green carbonate of copper, often radiated and fibrous, and of the highest possible percentage. We could also knock out or pick up on the hill side, or in the gullies, heavy boulders of red oxide of copper and grey ore.

The Argylla property will take a large sum of money to explore. No company without very considerable capital should, in my opinion, attempt the task, but I believe the expenditure would be richly repaid. The green-painted caves in the quartz, I have no doubt at all, represent great bunches of ore which have been denuded. . . .

(4) To the above Mr. Cameron added:

Since Mr. Jack's visit some little attempt has been made to investigate the resources of the lode. Two cuttings towards the southern end of the outcrop, and some 150 paces apart, have been put in in the western side of the hill. They expose first talc schists, and then about 5 ft. of a weathered sandy rock impregnated with copper glance and carbonate in irregular patches and veins.

An average sample of the portion of the lode exposed gave 15·95 per cent. copper, a trace of gold, and 2 dwt. 22 gr. of silver per ton from the northern cutting, and 35·2 per cent. of copper, a trace of gold, and 9 dwt. 2 gr. of silver per ton from the southern cutting. An irregular trench on the summit of the outcrop, some 70 ft. east-north-east of the southern cutting, is about 6 ft. deep and 6 ft. across, and goes east for 20 ft., and then north for about 18 ft. It exposes decomposed talcose and sandy schists with scattered veins of quartz and carbonate ores running through it. About 10 or 12 tons of picked ore are lying in the trench. An average sample taken from this picked ore gave a return of 20·75 per cent. of copper, a trace of gold, and 4 oz. 2 dwt. 8 gr. of silver per ton. To all appearances the Argylla Outcrop should be able to furnish a considerable quantity of ore of a value quite equal to that found in the trench on the summit, and the cuttings into the walls. The working of the lode would no doubt mean the removal of a great quantity of valueless material, but the ore would be easily picked from the gangue, and according to the assays of a very good percentage. The extent and value of the copper-bearing belt could be comparatively easily proved by surface trenching along the line of strike of the lode.

(7) Mr. Rutherford's description is as below:

This includes a succession of parallel beds of altered sandstone lying on schist forming a range running north-west and south-east for 2,000 ft. and rising to a height of 80 ft. above the general level. The rock is coloured a bright green in places with copper carbonate. This staining is very patchy, and is most pronounced in joints and in natural caves in the rock. In places small seams of red oxide and glance are seen. . . .

Following the outcrop to the north it ends in barren, tough quartzite, and at its southern extremity it ends abruptly, and does not outcrop anywhere down the side of a steep schist hill.

This belt of country, which is similar to many others seen in the district, contains a few seams of rich glance and red oxide scattered in a detached irregular manner through the formation. Due to the enormous amount of dead work which would have to be done to mine any of this ore, I consider that it would be an unprofitable undertaking.

(1) Mr. Linedale in a report dated 31st October, 1907, states:[1]

A few days ago I paid a flying visit to the Argylla Freehold. The West Cloncurry Copper Company, Limited, has closed down all its mines in this locality, but the Freehold is still being prospected. In the latter property, No. 1 shaft is down a depth of 100 ft., and crosscuts at that level have been extended north-east and south-west. The south-west cut has penetrated a distance of 100 ft., the first 30 ft. being through a formation carrying bunches of quartz and nodules of limonite and oxidised copper ores. The north-east cut is in 130 ft., the first 40 ft. of which pass through a formation carrying a little copper, and from thence to within a few feet of the face a body of schist, slightly impregnated with copper, was passed through. The face of the cut is now in a formation of crushed quartz, showing stains of copper carbonates. No. 2 shaft was sunk to a depth of 100 ft., and crosscuts extended north-easterly and south-westerly 40 ft. and 100 ft. respectively. The former cut passes through bars of diorite and quartzite carrying a little copper sulphides, and the latter for some distance is through a formation of quartzite and limonite impregnated with carbonate of copper. The end of this cut is in micaceous schist.

Development.

Four cuts have been opened on this property. The northernmost (not seen by me) is stated to be 30 ft. long. At 7 ch. to the south is a costean 25 ft. long and 6 ft. deep. The third cut, 1 ch. to the

[1] Q.G.M.J. Nov. 1907.

north-east of and 30 ft. above the last mentioned, is 7 ft. deep and runs 15 ft. south-west and then 15 ft. west. The fourth cut (not seen by me) is said to be 9 ft. long and to be just above the third.

ORE-BODIES.

Only two ore-bodies were seen by me. That at the southern trench comprises kaolinised slates dipping about 80° to the west-south-west and impregnated and replaced to varying extents, over a width of 4 to 5 ft., by cuprite, round which mineral the kaolin is considerably stained by malachite. The crop, consisting of kaolinised slate variously veined and impregnated with malachite, is traceable for 40 ft. to the south-south-west of the trench. This may be expected to yield some rich ore.

The main ore-body, at the upper trenches is U-shaped, the U being 1½ ch. in length and 40 ft. across, with the open end towards the south-east. The south-western arm consists of crushed carbonate veined quartzite, 6 ft. wide and passing into "silicified limonite" and then into quartzite towards the end. This is low-grade at the best. The northern arm is 15 ft. in width in one place but the trench exposes only kaolinised slates with bunches of mixed tile ore and malachite bearing ore. The cut would seem to indicate that concentration of carbonates has taken place near the surface owing to kaolinisation of the rock there, and the prospects of meeting a large ore-body by sinking are therefore not very bright. Some tons of a very siliceous ore, rich in crystalline malachite, are stacked here.

The crest of the Argylla ridge is of a siliceous rock—presumably silicified slate—but, Mr. Conder's sections, to which reference has previously been made, prove that certain of the dark-coloured rocks in the vicinity are altered diorites.

Advance (M.C. 338).

Mgr., Canlons.

LOCATION, ETC.

The Advance lies 3 miles south-east of the Argylla.

Its area is 800 ft. × 350 ft.

Three shallow holes have been opened.

OUTPUT.

12 tons shipped.

ORE-BODIES.

The ore-bodies comprise small bunches of rich ore (carbonate and oxide) with limonite in quartz. The country rock is a hornblendic rock producing a soil rich in calcareous sinter.

PALM-TREE.

A number of ore-bodies, among which may be mentioned the Cleanskin and Little King, have been worked at various times in the ranges at the head of Palm-tree Creek. The miners, however, have no confidence in their permanence, and, even in the vicinity of the Native Companion, several have not considered it worth while to register their claims.

In addition to those mentioned below, the plan accompanying Mr. Cameron's report shows a lease called Mount Bracewell, adjoining the Enfield on the north, and another called the South Mullen, lying 1½ mile to the north-west. No important ore-bodies were found on them, and they have now been abandoned.

NATIVE COMPANION GROUP.

Small crops of copper ore in schist are numerous in the vicinity of the Native Companion, and for at least 2 miles to the north, but except on the reward claim very little work has been done. The shoots at the surface are very short, but may possibly prove more extensive at a depth.

Native Companion (R.C. 19).

Location, Etc.

The Native Companion is located on the north-western side of Palm-tree Creek, 7 miles south-south-west of Quamby, on the Camooweal road, and 26½ miles north-west of Cloncurry.

Its area is 160 ac. The property is held by the Leichhardt-Cloncurry Company.

Development.

The main shaft, which is in the south-western corner of the lease, 10 ch. from the boundary peg, is 34 ft. deep, and has drives running 12 ft. to the south-west and several feet to the north-east at the 25-ft. level, which is just above water. Work ceased here because of a heavy influx of water, probably from the creek, which is 7 ch. distant. It is now proposed to install a pump. At 6 ch. to the north-east of the above there is an opencut and old shaft, caved in below a depth of 15 ft., but from which at the 30-ft. level a drive ran 50 ft. to the south-west. Another old shaft, 15 ft. deep, lies 1 ch. to the north-north-east of the last, and from this also there was a drive southwards.

The other workings comprise costeans at ½ ch., 2 ch. and 4 ch. north-east of the main shaft, a pothole alongside the Quamby track, near the northern boundary, and a costean on the bank of Palm-tree Creek, 4 ch. south-east of the last. One man was at work here on costean No. 3, at the end of the year 1906.

Output.

1904	...	...	33 tons shipped, carrying 49 to 52% copper.
1905	...	...	$40\frac{15}{20}$,, ,,
	Total	...	$73\frac{15}{20}$,, ,,

Ore-bodies.

Two small shoots of payable ore have been located on a north-east and south-west line and, though small near the surface, further prospecting to test whether they increase in size at a depth is fully warranted.

Ore is stated to have been found at the surface on the site of the main shaft, though there is no trace of it to the south-west. In the shaft the ore-body had a width of 2 ft. 6 in. from wall to wall, but it pinched out in the drives, the face of the eastern showing only kaolinised micaceous schist country, with flat bunches of chalcopyrite, but no defined body. There is, however, a likelihood of further bodies being picked up, if the drive is continued. Nearly 50 tons of ore have been shipped from this shaft. The tip consists of crystallised quartz and kaolin with a little chrysocolla, and the whole of the material should carry 5% copper.

At the surface of the old shaft and cut can be seen 2 to 5 ft. of copper-stained clay-slate on end, and it is said that there is ore underfoot all along the bottom of the drive, where the formation is 2 ft. wide; and that 1 ton of 36% ore came from the drive. Some 29 tons of ore have been shipped from here. The seconds, of which there are 20 tons at grass, consist of kaolinised slate, stained on joints and carrying about 5% copper.

The three costeans between the old and new shafts have failed to expose a continuation of the ore-bodies worked. The first two are in a shattered calcareous slate, and the third is in a dark micaceous schist, in which ore-bodies may be found by sinking. At 4 ch. north-east of the old shaft, a crop of quartz has been located in schist, and blocks of ore are found on the surface in the vicinity.

At the northernmost shaft only copper-stained formation was found.

The northernmost pothole is in a decomposed calcareous tourmaline-bearing rock. Only $\frac{1}{2}$ ton of copper-stained rock containing a little glance is at grass. Nothing definite can be seen.

Numerous small patches of ore are to be seen in the north-eastern part of the claim, but nothing has been done to test them, except in the one trench, on the bank of the river, which exposes slates striking north-by-east and stained, over a width of 2 ft., by copper minerals and, over 4 ft., by iron minerals. One of the crops of siliceous gossany rock is of some size, and in the vicinity bunches of ore occur in siliceous slates and schists.

Unnamed (M.C. ?).

Mgr., Cummins.

LOCATION, ETC.

This claim lies ¼ mile north of the Native Companion.

One trench, 5 ft. deep and 10 ft. long, has been opened here.

ORE-BODY.

There seems to have been a bunch here the length of the trench, striking north and south and dipping 70° to the east, in a bluish clay-slate. In the latter part of 1906, 4 tons of ore were shipped from the claim. The seconds, of which there is 1 ton at the trench, consist of siliceous limonite, with radiating spheres of malachite (sometimes coated by secondary silica) and with mammilated coatings of chrysocolla on the joints.

Good Luck (M.L. 353).

Mgr., Alman.

LOCATION, ETC.

The Good Luck lies 3 miles north-west of the Native Companion.

Its area is 9⅘ ac.

No work has been done here beyond the sinking of a few potholes.

LITERATURE.

For title of report, numbered as below, see Introduction.

(7) Mr. Rutherford says:

On the surface loose boulders of jasper, lying on mica schist and stained with green carbonate, were seen.

ORE-BODY.

The outcrop is understood to be very siliceous, but somewhat ferruginous, and is shown on the survey plan as striking north-west and south-east.

Enfield (M.L. 61).

LOCATION, ETC.

The Enfield is understood to be on Palm-tree Creek 7 miles south-south-east of the Lady Clayre.

The lease has now been abandoned.

LITERATURE.

(4) Mr. Cameron wrote:

South of Lease No. 61 are seen vertical north and south striking mica schists and fine felspathic sandstones. Four pits sunk on indications of copper expose soft white kaolinic material carrying rich glance associated with quartz. The quartz shows free gold in coarse grains. The kaolinic material is evidently derived from the decomposition of a felspathic rock, and the ore is evidently a concentration of copper along a more or less definite line. There is no sign of a

distinct lode. Trenches further south show a considerable amount of copper staining of the rocks, but a less amount of glance. Further north, on Lease No. 61, the rocks are considerably copper-stained, and blocks of glance ore can be knocked off from many of the outcrops. Similar occurrences of ore are found over most of the leases in this neighbourhood, but on none of them has anything of much value been found up to the present.

(7) Mr. Rutherford says:

Starting at the northern end on the "Enfield," a contorted micaceous sandstone carries in places nodules of copper glance, and is freely stained with carbonate. Three tons of rich ore were collected from the surface by Mr. Henry and sent away. Going south, the sandstone is altered to a ferruginous quartzite, which does not show any stains. Continuing sixty yards to the south the sandstone shows again on the other side of a gully and shows stains in patches. A bed of calc-spar immediately to the west also shows carbonate stains. The copper in these leases occurs in a very patchy manner in sandstone, which is scattered loosely over the surface of mica schist. . . .

Oliver Twist (M.C. ?)

Mgr., Cummins.

Location, Etc.

The Oliver Twist lies 6 miles south of the Native Companion.

There are stated to be two shafts, 12 ft. and 15 ft. deep respectively.

Output.

	15	tons,* shipped by	Cummins.
	14	,, ,,	Bald.
Total	29	,, ,,	

Ore-body.

The copper ore is reported to have had small vertical extent, presumably occurring in bunches in a vein of quartz 18 in. wide.

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* 1 ton of this consisted of cuprite and native copper.

DUGALD RIVER.

The Dugald River groups, here dealt with, are all within 10 miles of where the Camooweal road crosses the river, 40 miles north-west of Cloncurry, though deposits have been, and others will in the future be, found southwards to the Cameron and Argylla. The ore deposits examined show more diversity of occurrence than is to be found over most of the rest of the field, and this is due to the neighbouring intrusive tongue of granite, which is continuous from here to within a few miles of the Cloncurry township. The connection between the copper ores and the granite is best exemplified at the Magnet and Mavis, more especially the latter, where copper is found with magnetite in a porphyritic rock, in juxtaposition to the granite.

Spotted schists are characteristic of the country in the vicinity of the Two Sports, but the rocks are in so decomposed a state that it cannot be determined whether the spots represent incipient secondary crystals in a sedimentary or kaolinised phenocrysts in porphyry.

UNA GROUP.

Only one mine was working here, but there is a likelihood of others being taken up in the neighbourhood, as indications of copper are abundant to the south.

No work to speak of had been done on the Una North Block, the Ivy, and the Una South, which are consequently not included here.

Una (M.L. 280).

Mgr., McGrath.

Location, Etc.

The Una lies 1 mile east of the Dugald River, 8 miles west of Quamby, on the Camooweal road, and 33½ miles north-west of Cloncurry.

Its area is 9 ac. The Leichhardt-Cloncurry Company had just taken the property over at the time of my visit.

Development.

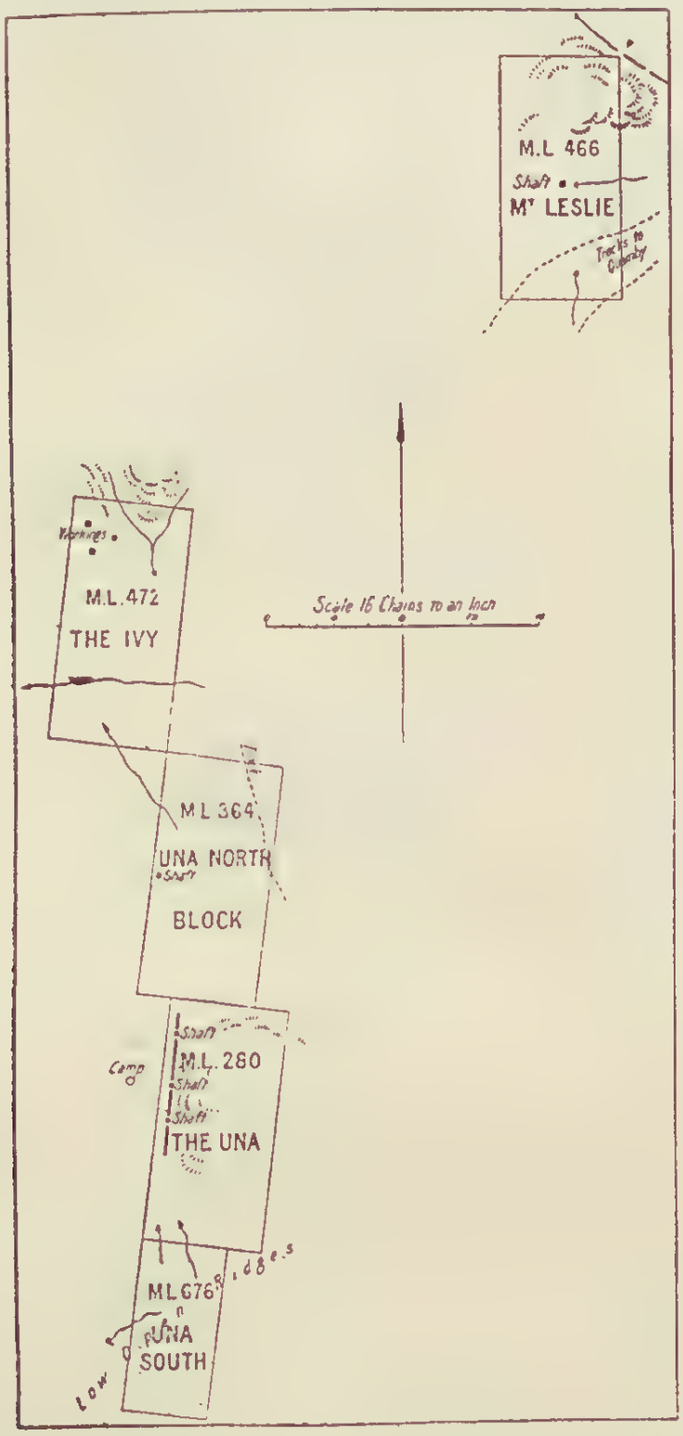
The main shaft, which is 7 ch. from the southern boundary, is 40 ft. deep; at the bottom there are drives for 30 ft. north and 20 ft. south; and above the former a stope has been carried up to within 20 ft. of the surface. No. 2 shaft, 50 ft. north of the main shaft, is 12 ft. deep. No. 3 shaft, 50 ft. further north, has been filled in to within 10 ft. from the surface with material from a trench running 12 ft. to the south. No. 4 shaft, 1 ch. north of No. 3, is 10 ft. deep. No. 5 shaft, about 75 ft. south of the main shaft, is 10 ft. deep. The only other workings are trenches 25 and 50 ft. south of No. 5 shaft, the former 20 ft. long and 6 ft. deep.

Output.

1905	... ...	12 tons shipped by Alman and party.
1906	... ...	53 ,, ,, ,, ,,
Total	...	65 ,, ,,

Ore-bodies.

One ore-body, yielding over 50 tons of ore, has been located, and there is promise of several others being discovered by sinking on the line of strike, favourable indications having been already proved.



The ore-body in the main shaft strikes north 10° east, and dips 5 in 1 to the east. The shaft was sunk on a cupriferous formation, 2 ft. wide, with a gossany footwall, and well defined from the decom-

posed slate hanging-wall. Along the top of the stope there is 2 ft. width of copper-stained kaolinised and silicified rock, with a few inches width of gossan on the footwall. In the face of the northern drive also the ore has pinched down to 12 in. width, but is making again underfoot. The southern drive shows only 6 in. malachite, with patches of earthy secondary sulphide in the face, and the walls are ill defined, the gossan there being on the hanging-wall side. Most of the ore shipped must have come from these workings. The whole tip is cupriferous, and should yield between 2% and 3% copper.

No. 2 shaft met only very slight and occasional stains of copper.

No ore can now be seen at No. 3 shaft, which, however, was probably sunk on a bunch, on the line of that in the main shaft.

No. 4 shaft, the farthest north, was opened in kaolinised country, but seems to have cut the cap of an ore-body at 8 ft. depth, where there is dense limonite, with a little malachite, showing.

No. 5 shaft exposes formation, but no copper is present.

The first trench to the south of No. 5 shaft, however, shows 12 in. width of copper-stained and copper-bearing altered country rock. The second trench also shows slight stains, and about 5 ch. beyond, to the south, some copper stains and replacements have been located in kaolinised and brecciated slate.

Mount Leslie (M.L. 466).

Mgr., Henry.

Location, Etc.

The Mount Leslie lies 1½ mile north-east of the Una.

Its area is 10 ac. Being deserted, it was not inspected by me.

Literature.

(4) Mr. Cameron says of the old lease:

A shaft sunk on Lease No. 36 some 50 ft. in depth, and a drive east some 50 ft., have failed to expose indications of copper, though I am informed blocks of rich ore were found on the surface.

(7) Mr. Rutherford states:

From a small outcrop Mr. Henry sent away seven tons of red oxide, which assayed 43 per cent. Cu., all occurring within two feet of the surface in a concretionary form.

LADY CLAYRE GROUP.

The only mine in this group offering any encouragement to continued mining is the Dispute.

Lady Clayre (M.L. 279).

Mgr., O'Keefe.

Location, Etc.

The Lady Clayre is situated on a low ridge 2½ miles north-west of the Una.

Its area is 10 ac.

Development.

The main shaft on the centre line of the lease, 5 ch. from the northern boundary, is 45 ft. deep, and a crosscut is being carried eastwards at the bottom (16 ft. in, in November last). Another shaft, 1 ch. south of the main shaft, is 19 ft. deep. A pothole 5 ft. deep lies 4 ch. from the south-western corner; besides there are costeans, just south of the main shaft, nearly 50 ft. long, 4 ch. south of the southern shaft, 6 ft. deep and 30 ft. long, and 2½ ch. west-north-west of the main shaft, 30 ft. long.

Literature.

For titles of reports, numbered as below, see Introduction.

(4) Mr. Cameron describes Lease No. 21 as below:

. . . . The surface indications of copper have been prospected by three trenches, which expose vertical north and south, striking felspathic sandstones. The ore occurs mainly as carbonate along the bedding planes, and is associated with quartz in veins running parallel with the bedding. The most northerly cutting is 48 feet long and 10 feet in depth, and it exposes a belt of copper-bearing rock about 18 feet in width. The better ore has been picked from the gangue, and stacked on one side of the trench. An average sample of it gave a return of 15 per cent. of copper, a trace of gold, and 16 oz. 8 dwt. of silver per ton. The second trench lies about 25 yards further south, and is 40 feet in length, and about 10 feet in depth. It exposes a similar formation to trench No. 1, about 6 feet in the centre being copper-bearing. Picked ore from here gave a return of 26·4 per cent. of copper, a trace of gold, and 16 oz. 8 dwt. of silver per ton. About 70 yards further south is the trench, 30 feet in length, and 10 feet in depth. The copper-bearing rock here has narrowed considerably, being barely 1 foot in thickness. The ore apparently does not occur as a well-defined and regular lode, but is no doubt an impregnation of a narrow belt of rock. Its extension further north of trench No. 1 should be prospected by a series of cross trenches. Trench No. 1 shows that there is a good body of 15 per cent. ore to be got in its neighbourhood, but the ore does not appear to occur in any quantity further to the south. Several other outcrops of ore occur on the lease, but they do not as yet appear to be of much consequence.

(7) Mr. Rutherford writes:

This lease encloses a low ridge of vertical ferruginous sandstone, impregnated with copper in small veins, running parallel to the bedding in a north and south direction. Starting at the northern end, a trench has been cut 47 feet across and 7 feet deep at its deepest part. It shows 29 feet of this carrying small veins of copper glance decomposing to carbonate. The southern side of this cutting shows less copper than the northern side, and the bottom of the trench is more barren than the top. Thirty yards to the south is a second trench 36 feet long and 5 feet deep, including 3 feet of vitreous quartzite, which have not been cut through. The sandstone here is much kaolinised. The north side shows a few good patches of carbonate, but the south side is almost barren. Eighty-six yards south from this second trench is a third trench 29 feet long and 8 feet deep. The sandstone here is harder than in the other trenches, and, like the second, carries the same quartzite, which has not been cut through. The walls show very few stains, and these are almost entirely confined to the quartzite. Following the same line to the south, a few stains can be seen here and there for a distance of 250 yards. Parallel to this line of impregnation, and higher up the ridge to the west, the sandstone is impregnated with carbonate in a similar way to that just described, but to a lesser degree. At the north end a trench 50 feet long and 7 feet deep shows the stains to be most plentiful in a quartzite bed which is interbedded with the sandstone. The sandstone between these two lines of impregnation at their northern ends is freely impregnated with copper of copper, and will no doubt yield to a shallow depth similar ore to that got in the northern trenches. . . .

ORE-BODIES.

Little of promise is to be distinguished here, the ore apparently occurring in small bunches. A lot of trenching has been done, the result of which has been recorded by Messrs. Cameron and Rutherford. The country rock is tilted slate (not sandstone) variously altered, chiefly by silicification, and one outcrop of limestone is to be seen on the lease. The general run is north and south, but, just to the north-west of the main shaft, the strike is west-north-west.

The main shaft has been sunk in slightly copper-stained gossany country to a "floor" at a depth of 19 ft., and similar country was met within 3 ft. of the shaft in the crosscut. This crosscut is being put in to test a belt of copper-stained and ferruginous country, exposed over a width of 25 ft. in a costean to the south of the shaft.

The southern shaft is sunk in slates, some parts of which are much silicified and bleached, while others are stained by malachite and contain bunches of fairly rich ore over a width of 6 ft. The rich ore consists of limonite, with some tile-ore and masses of malachite.

Several patches of carbonates in slate have been found to the south of this shaft, but in the southern costean only altered country with stains and small bunches of malachite-bearing slate are now exposed.

The western pothole shows impure limestone, across which a body of gossan, 12 in. to 18 in. wide, runs from east to west, probably on a joint. The gossan is rich in tile-ore and carbonates, and should yield 20% copper. A cherty quartzite lies to the east of the limestone, and on the edge of it a bunch of rich tile-ore and radiating malachite was found in quartz, the yield being 2 tons of 60% ore.

The western trench proved only copper-stained siliceous slate; but, at 1½ ch. north-west of the main shaft, there is a patch of gossan, with tile-ore and malachite, in silicified slate, from which 2½ tons of 30% ore could be culled.

Lady Clayre South (M.L. 413).

Mgr., Henry.

LOCATION, ETC.

This adjoins the Lady Clayre on the south.

Its area is 10 ac. The ground was deserted in November last.

One shaft has been sunk 10 ft., and some surfacing has been done.

ORE-BODIES.

Nothing is to be seen as to the nature of the ore-bodies, the trenches being in sintery red soil, probably produced by the decomposition of a ferruginous slate. Several tons of rich ore are stated to have been shipped from here, and there is paddocked 1 ton of siliceous limonite seconds, containing stains of malachite and specks of chrysocolla.

Dispute (M.L. 696).

Mgr., Botham.

Location, Etc.

The Dispute lies 20 ch. west of the Lady Clayre. When inspected, the ground was held as the Kathleen (M.C. 202).

Its area is 5 ac.

The main shaft is 20 ft. deep; a second shaft, 12 ft. deep, lies 12 ft. to the north; a third lies ½ ch. to the east; and a fourth is 1½ ch. to the south-east.

Output.

	15	tons shipped by different parties (report).
	4	„ at grass, carrying between 30% and 35% copper.
Total	19	„

Ore-bodies.

An oval area, 5 ch. in length (north and south) and 3 ch. in width (east and west), in which are the workings is worthy of thorough trial, the whole surface being more or less gossany. The area is on flat ground, and the easiest way to prospect it would be by sinking a central shaft and then cross-cutting and driving. The underlie will probably prove to be to the west, as the country dips in that direction.

A cellular gossan crop, with slight copper stains, runs for 2 ch. to the south-west from the main shaft. This should be tested by potholes or by a drive from the main shaft, at, say, 50 ft. depth. The main shaft itself is in a gossany formation, in which occur irregular bunches of limonite carrying malachite. This, though poor, offers every encouragement to further sinking.

The northern shaft has been sunk in gossan and slate, and 9 tons of ore have been shipped.

From the eastern and south-eastern shafts 3 tons and 1½ ton have been shipped.

Balaclava (M.L. 161, Etc.).

Location, Etc.

The Balaclava leases lie 2 miles north of the Lady Clayre. They have now been forfeited.

Literature.

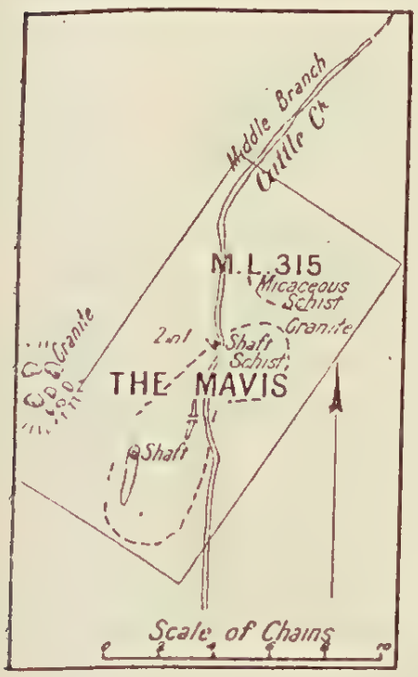
For title of report, numbered as below, see Introduction.

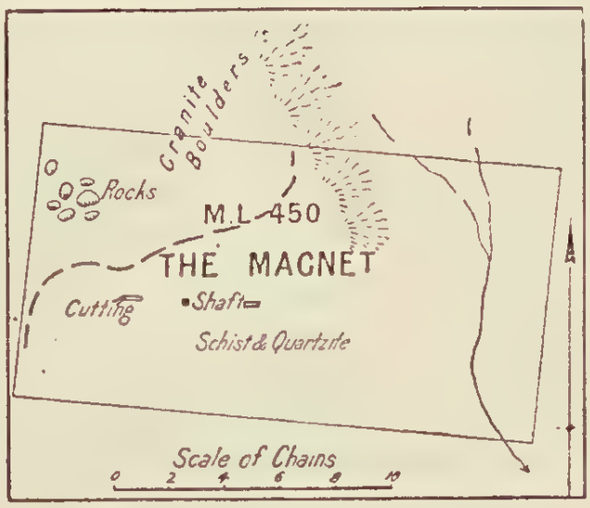
(7) Mr. Rutherford, in referring to the Balaclava leases, remarks:

They had been taken up to enclose several disconnected patches of stained ground. The first patch seen was on the north side of a nameless creek, where six feet of the bank showed kaolinised felspathic sandstone impregnated with copper carbonate. It appeared to be a small pocket on the surface, and could not be traced in any direction. Some distance further north another small patch of stained ground was seen, and beyond a low eminence of very friable sandstone, impregnated with malachite, deposited in a radiating fibrous form in cavities in the rock. This sandstone is lying loosely on the surface of quartzite.

LONGAMUNDI GROUP.

The Longamundi Group comprises several freeholds and leases on disconnected ore-bodies, of considerable interest, because of their varied forms.





Mavis (M.L. 315).

Mgr., McGrath.

Location, Etc.

The Mavis is located on Cattle Creek, 2 miles south-east of the Magnet and 1 mile from the Camooweal road.

Its area is 10 ac. At the time of my visit the lease had just been taken over by the Leichhardt-Cloncurry Company.

Development.

The main shaft, underlying 2 in 1 to the north-west, is sunk below the bank and beside the bed of Cattle Creek, and is reported to be 40 ft. deep, and to have been driven from. It is now used as a well, and is consequently not to be inspected below 30 ft. from the surface.

There is an old shaft, 10 ft. deep, 4 ch. south-west of the main shaft, and an old costean 3 ch. south of the same.

Output.

1905 ... ... 13 tons shipped from Mavis, etc.

Ore-bodies.

There is here an area of extremely metamorphosed rocks, irregularly intruded by granite. The lithological associations are indistinct, but the lease appears to be located near the periphery of the intrusive granite, the patches of black micaceous rock representing outlying "floaters" of intensely metamorphosed sedimentaries.

The deposits are of a most unusual kind, but nothing of any value is offering here. Alongside the main shaft is a dyke of pink granite, very fine in the grain, except for irregular patches of crystallised quartz and felspar giving it the character of a pegmatite. North-west of the dyke massive granite occurs, while on the south-east there is an outlier of dark schist. The shaft is sunk in a granular granitic rock—possibly a crystalline sedimentary—consisting of crystallised pink orthoclase, a little granular quartz, flakes of biotite (perhaps also with chlorite), together with some iron ore, sometimes present to the exclusion of all the other minerals. The whole of the rock is stained throughout with blue and green carbonates, but does not carry more than 1% copper. The iron ore appears to follow a joint as a footwall, and its crop can be traced for ½ ch. to the west-south-west, and to the creek drift ¼ ch. to the east-north-east. The crop of altered granite, 2½ ch. east-north-east of the shaft, is probably on the line. The iron has every appearance of being due to segregation from the intruding magma, while the copper may have been derived from basic minerals in the sedimentaries during their metamorphism.

A surface sample was taken from the material tipped alongside the shaft, but is probably too high in copper, which has been somewhat concentrated on cracks. It consists of one quarter chloritic quartz-felspar rock, stained with malachite and containing glance and also a little calcite; one half decomposed porphyritic schistose rock, stained with malachite and azurite, containing a little bornite and sometimes quartz-bearing; quartz, sometimes intercrystallised with felspar; and a little coarsely granular ilmenite with felspar phenocrysts in serpentinous rock. The following is the result of its analysis (Government Analyst):

Copper	... ...	10·6%.
Gold	... ...	1 dwt. 14 gr. per ton.
Silver	... ...	9 „ „

The reddish cellular outcrop, south of the shaft, is seen in the trench to be 10 ft. across, and to consist chiefly of crystalline reddish orthoclase, in the interspaces of which is white calcite, while scattered through it are slightly rounded crystals of quartz. There is also a small quantity of chlorite, accompanied by a little malachite, and occasional grains of iron ore were noticed.

A similar outcrop is to be seen at the old shaft, where, however, stains of malachite are rather more pronounced.

Magnet (M.L. 450).

Mgr., McGrath.

Location, Etc.

The Magnet is situated 1 mile south-west of the Camooweal road, 1 mile east of the Dugald River, and 36½ miles north-west of Cloncurry.

Its area is 19 ac. The lease is held under option by the Leichhardt-Cloncurry Company, but had only just been taken over at the time of my visit.

Development.

The workings may best be described in their order from west to east. The first shaft is 17 ft. deep; a few feet to the east is a pothole; and 20 ft. to the east-north-east is an opencut, 45 ft. long, 6 ft. deep, and 5 ft. across. About 50 ft. east of the cut is the main shaft, 40 ft. deep, and 14 ft. beyond are two potholes 10 ft. deep. The only other excavation is a trench 30 ft. long and 8 to 10 ft. deep, 1¼ ch. east of the last.

Output.

1905	30 tons shipped by R. Love.	
1906	13 „ „	(Magnet)
Total ...	43 „ „	

Ore-bodies.

There is here a series of over-lapping lenses, on a line which, east of the main shaft, lies approximately east and west, but on the opposite side gradually bends round, and in the western shaft has a strike of north-east and south-west, the dip varying from north to north-west, and amounting to 80°. The country rock adjacent to the ore-bodies is a dark mica-schist, the strike of which is generally east and west and in agreement with that of the ore-bodies. Local variations are noticeable, especially in the long cut and in the main shaft, where the schistosity abuts against the footwall as if on a cross-fissure. The wall-rocks are also there much kaolinised for 6 in. from the ore.

The ore-bodies would appear to be developed in mica schist along an imperfect line of fissures, directly due to the intrusion of the granite, which may be seen within 1 ch. west of the workings and 2 ch. to the north. The irregular contact of the two rocks, as far as visible, is the only evidence of the intrusive nature of the granite, the area to the north being, presumably, an off-shoot from the main mass to the west.

At the western shaft and pothole four separate cupriferous formations can be distinguished. The southernmost in the pothole, which is on the line of that exposed in the other workings, is probably only a bunch, 2 ft. 6 in. wide at the most. At 18 in. to the north-west a crop, 12 in. wide, runs between the pothole and the shaft; and 18 in. beyond it is a body, 3 ft. wide on the eastern side of the shaft, but only a few inches wide in the south-western corner of the same. The fourth body, which is separated from the last by 3 ft. width of quartzite, is 2 ft. 6 in. wide on the eastern side of the shaft, but tapers down to a few inches on the western. Ore has been shipped from this shaft, and the 7 tons of seconds, consisting of limonite and quartz, with malachite and a little enriched chalcopyrite, will probably average 10% copper, besides which the whole of the mullock tip should yield 2% or 3% copper.

The long cut is on a formation, 1 to 4 ft. in width, passing eastwards into quartzite, in which are occasional patches of carbonates. This can be followed almost to the main shaft, its width in one place being 10 ft. There are 7 tons of seconds at grass, very siliceous, coated with clay, and not likely to yield more than 5% copper.

The main shaft was begun on a formation, nearly 6 ft. thick. In this is a vein of gossan, which near the surface is 3 ft. wide in the eastern end, but pinches to 9 in. in the western end. Where thickest it is very siliceous, and probably does not contain more than 5% copper. Below a depth of 10 ft. the average thickness of well defined gossan on the western side of the shaft is 12 in. On the eastern side the lode pinches still further, being only 3 in. wide at 30 ft. below the surface. The whole of the material raised from the shaft shows traces of azurite, and the tip should carry between 1% and 2% copper. The paddocks hold 3 tons of gossany tile-ore and carbonates, which should run 20% copper, and 5 tons of siliceous ore worth 10% copper.

The first of the potholes exhibits a formation 7 ft. wide in the western end, and 2 ft. wide in the eastern, contracting downwards to 18 in. The seconds paddocked amount to 10 tons. They comprise siliceous gossan with carbonates, and are likely to yield 15% copper.

In the second pothole the formation increases from a width of 2 ft. 6 in. at the western end to 6 ft. at the eastern end.

The eastern trench exposes two over-lapping lenses of cupriferous gossan, perhaps 18 in. apart, the one being 12 in. wide at the western end, and the other 18 in. wide at the eastern end. The ore in the faces should carry 20% copper. The seconds, of which there are 3 tons at grass, are very siliceous, but will assay 15% copper. There is very little copper in the tip, as a whole.

O'Brien's (M.C. ?).

Mgr., O'Brien.

Location, Etc.

This claim is located alongside the Camooweal road, 2 miles south-east of the Dugald River crossing.

The claim was deserted when seen.

The main shaft, which underlies 3 in 1 to the west, is 20 ft. deep, and a second, 12 ft. to the south, is 8 ft. deep.

Output.

1906 ... ... 3 tons of ore bagged.

Ore-body.

The shafts are in a cupriferous formation in schist country, striking north and south and underlying westwards. The total width of the formation is 2 ft. 6 in., and in this the ore occurred in bunches,

of which few now show in the faces. Besides the 3 tons of ore bagged there are at grass 2 tons of seconds, very siliceous carbonate-bearing ore, the copper content of which does not exceed 10%.

Scanlan's (M.C. ?).

Mgr., Scanlan.

Location, Etc.

Scanlan's lies only ¼ mile south of O'Brien's.

It was idle when visited, and only one hole has been sunk 6 ft.

Output.

1906 ... ... 2 tons of ore at grass.

Ore-body.

A lenticular body of ore, striking north and south and dipping westwards, is being opened in schist country. The ore consists of limonite and enriched chalcopyrite, with stains of malachite, and appears to be rich in copper. There is little quartz at the hole, but that mineral becomes more plentiful to the south.

Havelock (P.A. ?).

Location, Etc.

The Havelock lies 1 mile south-east of the Patchwork.

Several small bodies of ½ to 2½ tons of ore have been found, but no defined lode has yet been located.

Patchwork (M.C. 349).

Mgr., Lanson.

Location, Etc.

The Patchwork lies about 2 miles south of the Dugald Crossing on the Camooweal road.

Its area is 200 ft. × 350 ft.

A shaft has been sunk 15 ft., in the north-western corner of the claim; 3 ch. to the east-south-east is a hole 10 ft. deep; and, for 4 ch. to the east-south-east from here, a string of potholes extends.

Ore-bodies.

The north-western shaft is in a break in the schists, striking north and south and dipping 4 in 1 to the east, here and there along which small bunches of cupriferous quartz are found. This does not appear to be worth any more attention. The 2 tons of seconds, at grass, comprise quartz, with a little chalcopyrite in the solid part and tile-ore and carbonates in cracks; and they may carry 2% copper.

The first hole to the east-south-east was sunk on a bunch of ore, running west-north-west, which has now been stoped out.

The potholes to the east-south-east appear to have been opened on small bunches of copper ore and of quartz carrying magnetite, no body of which has, however, been proven, though a formation 2 ft. 6 in. wide is exposed in one of the holes.

The deposits are valueless copper propositions, but the occurrence of the iron ore is interesting.

Two Sports (M F. 2874).

Mgr., Henry.

Location, Etc.

This is on the western side of the Dugald River, 1 mile above the Camooweal road crossing and 38½ miles north-west of Cloncurry. When visited by me a claim known as the Two Sports had been pegged out, there being nothing to indicate that the ground was freehold.

Its area is 31 ac.

The Dugald valley is here flat bottomed or only slightly rolling to the hills 3 miles to the west.

Development.

Most of the workings described below are due to prospectors, who have held the ground in ignorance of the fact that it is freehold.

The northernmost opening is a pothole (*a*); 5 ch. to the south is a costean (*b*), 4 ft. deep and several feet long; then, 5 ch. to the south-south-east of the last is a trench (*c*), 15 ft. long and originally 10 ft. deep; 30 ft. beyond is a hole (*d*), 5 ft. long, 10 ft. wide, and 5 to 10 ft. deep; 1 ch. further to the south-east is a pothole (*e*), 3 ft. deep; ¾ ch. east-north-east of the last is a pothole (*f*), 5 ft. deep; and 3 ch. east-south-east is a trench (*g*), 20 ft. long and up to 10 ft. deep; 3 ch. to the west-south-west of the last are two or three potholes (*h*), up to 10 ft. deep; 5 ch. south of these potholes is the latest working, a pothole (*i*), 6 ft. deep; and 2 ch. south of this is a costean (*j*), 50 ft. long and 8 ft. deep.

Output.

1906 ... ... 15 tons of ore bagged, estimated to carry 40% copper.

Ore-bodies.

Copper-stained spotted schistose slate here occurs over a belt 20 ch. in length and 3 ch. in width. The strata are tilted vertically, the strike being north and south.

The northernmost pothole (*a*) exposes only slightly stained spotted schist, dipping steeply eastwards, as in the costean (*b*). Between these old workings there is a belt, 1 ch. wide, which is bare of all vegetation, even spinifex, except copper grass.

Between the costean (*b*) and the trench (*c*) the country becomes much more ferruginous, and in the sides of the trench spotted schist with much silicified limonite can be seen. There are 2 tons of ore bagged here, and also 3 tons of ferruginous seconds, which may carry 3% copper.

The tip at the hole (*d*) contains a large amount of gossan. There seem to be two separate lenses of ore in this excavation. They are now covered by rubble, but are said to be strong in the bottoms of the workings. The firsts bagged amount to 9 tons, and the seconds, carrying 3% copper, to 8 tons. This hole is on the line of the main outcrops of the freehold, which appear at 5 ch., 8 ch., and 11 ch. to the south, but have not elsewhere been broken into.

The potholes (*e* and *f*) exhibit only stained spotted schist.

In the trench (*g*) a lenticular bunch of gossany ore would seem to have been worked, but in the end only a few inches of blackened limonite, dipping flatly northwards, can be seen. One ton of firsts is stacked at the trench, and there is near at hand 1 ton of gossany seconds containing 1% copper.

The potholes (*h*) are in copper-stained spotted schist, and 2½ tons of ore, now bagged near them, have been obtained from bunches of ore.

The newest hole (*i*) is also in spotted schist stained by malachite, and containing irregular splashes of cuprite. In working, green-stained cracks are followed till irregular veins and bunches, generally less than 1 in. thick, of cuprite are found, sometimes with a little native copper. Only ½ ton of rich firsts were bagged here, but there was also 1 ton of seconds, schist with veins of cuprite and stains of malachite, estimated to contain 25% copper.

The schists are stained to a limited extent for 1 ch. south of the hole. The southernmost costean shows very slight stains of copper in places. Some prospecting should be done on the gossany crop to the south-south-east of this.

Unnamed (M.F.'s 2873, 2902, and 2903).

Location, Etc.

These freeholds lie 1½ mile west of M.F. 2874 on the Dugald River.

Their areas are 21 ac., 20 ac., and 20 ac., respectively.

Literature.

(2) Mr. Jack refers to several copper and lead lodes in this district, but his description of location is insufficient for it to be stated that they are on these freeholds.

. . . . The lead selections lie nearest the range, and occur in a wide lode which can be followed on the surface for nearly a mile, from north 20 degrees west, to south 20 degrees east; not only by the continuous outcrop of gossan,

but also by the absence of vegetation. At the north end is a mass of gossan, stained with carbonate of copper, and mixed with plumbago. . . . A mile to the south-east of the lead lode is the No. 1 Copper Selection. It lies among upturned and altered stratified rocks. Near the river is a white crystalline limestone, 50 or 60 feet thick, with siliceous granules, and specks of black mica, dipping at 75 degrees to east 10 degrees south. Below the limestone is a series of grey siliceous and talcose slates or shales, impregnated and coated with green carbonate of copper. This series is of varying thickness—at least 100 feet—and is accompanied by a weathered granular siliceous and hornblendic rock, impregnated with carbonate of copper ("green gossan"), especially in the form of amygdaloidal kernels. These masses evidently are not part of the stratified series, but vein deposits or gangue, as they intersect the bedding in places, although their general tendency is to follow it. Two trenches have been cut across the outcrop of the cupriferous zone or lode (which runs north 10 degrees east). One trench is 22 yards long; it discloses a considerable quantity of the "green gossan," which cuts in and out of the bedding of the stratified rocks. The second trench is 20 feet long and 8 feet deep; it shows towards the bottom large blocks of ruby oxide coated with green carbonate, and frequently containing veins of native copper. The oxide is remarkably pure. Besides the "green gossan" large masses of ferruginous gossan occur on the cap of the lode. Large lumps of carbonate and oxide of copper can be picked up loose in the gullies near the lode.

CABBAGE-TREE GROUP.

Cabbage-tree Creek is a tributary of the Leichhardt River, but it is convenient to include these workings under the heading of Dugald River.

It was learnt from prospectors that there is an extensive cupriferous belt along the right bank of Cabbage-tree Creek, but that the ore-bodies themselves are small.

Cabbage-tree (M.F. 3072).

Location, Etc.

This is on the eastern side of Cabbage-tree Creek, 4¼ miles north-north-east of the crossing of the Camooweal Road Crossing.

Its area is 40 ac. It was deserted last year, and was therefore not inspected by me.

Literature.

For title of report, numbered as below, see Introduction.

(7) Mr. Rutherford wrote:

It shows felspathic sandstone impregnated in patches to a depth of a few feet from the surface by carbonate of copper. Four trenches were examined, and all showed impregnation to be to a shallow depth. The carbonate seemed to be due to the oxidation of glance, some bits of which were seen occurring in nodules on the surface.

GLENROY.

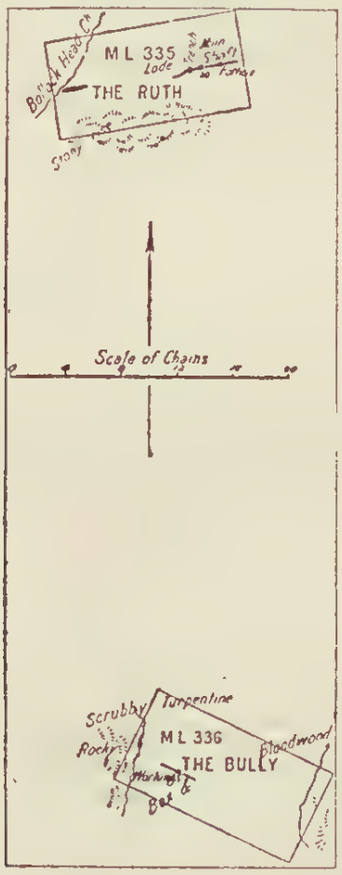
Glenroy is a station on the Leichhardt River, 53 miles west-north-west of Cloncurry.

The two groups are located on the divide between the river and Prospector Creek, which lies to the east.

MOUNT REMARKABLE GROUP.

Mount Remarkable is a conspicuous table-topped range, running for several miles along the western side of Prospector Creek, and beneath the northern end of it the Cloncurry-Camooweal mail road runs.

On the Bully very little work had been done at the end of last year, and, being then deserted, the lease was not visited.



Ruth (M.L. 335).

Mgr., Fisher.

LOCATION, ETC.

The Ruth is situated on a small branch (Bullockhead Creek) of Prospector's Creek, ½ mile from the Camooweal road and 50½ miles north-west-by-west from Cloncurry.

Its area is 10 ac.

The main shaft is 30 ft. deep; 1 ch. to the east there is a hole 8 ft. deep; 4 ft. to the south there is a trench, 10 ft. long; 12 ft. to the west there is a cut, 12 ft. long and 20 ft. deep; and 3 ft. beyond this a trench, 12 ft. long and 4 ft. wide, has been sunk 5 ft.

The mine happened to be deserted when visited, the leaseholders having left for Cloncurry to obtain rations.

Output.

1905	... ...	18 tons shipped.	
1906	... ...	39 ,, ,,	
Total	...	57 ,, ,,	averaging 25% copper.

Ore-bodies.

This appears to be a mineralised zone, in which there are probably numbers of ore-bearing lenses, but there is no sign of fissuring. Iron-stained quartzite, in which a few small patches of copper-ore have been found, forms a prominent crop, rising 15 ft. above the creek at the western end of the lease.

The crop is 3 ch. in length and up to 20 ft. in width at the western end. It strikes west-south-west and dips steeply south-south-east. Towards the west it is made up of alternating quartzite lenses, granular quartzite and crushed schist, most of the copper being in the last and none in the first. The average content is less than 5% copper, though the green surface stains might lead one to expect a higher percentage. The occurrence is thus almost exactly similar to that on the Chinaman freehold at Duck Creek. The central part of the crop is rather gossany, and patches of ore may be expected if it is sunk on. In the trench near the centre 9 to 18 in. width of quartz-bearing limonite, carrying malachite with a little chalcocite, is visible. It is understood that a little ore has been sent away from here.

The main shaft appears to have been opened on a crop of rich ore, which, however, thinned out eastwards and cannot be traced beyond the 8-ft. pothole, though there are slight indications 10 ch. to the east-north-east. Towards the west the crop breaks up into a number of over-lapping cellular, gossany lenses, the general trend there being west-south-west, whereas at the workings it is west 5° south.

At 15 ft. depth in the main shaft can be seen 3 ft. width of malachite-impregnated limonite on the north, 18 in. iron-stained slate and 12 in. cupriferous gossan on the south. At 20 ft. depth an inclusion of country rock proves the ore to be simply a bunch of replaced country. Cellular gossan, with secondary sulphides, has been raised from the lowest part of the shaft. The whole tip at the main shaft, containing, say, 50 tons of material, should run 15% copper.

In the western pothole there is 6 in. gossan and cupriferous formation, and several tons of gossan, carrying 5% copper, could be picked from the tip.

The first trench, to the west of the shaft, exposes 18 in. gossan at its eastern end, but at the western only 3 ft. of ill-defined gossany formation can be made out.

HAMILTON CREEK GROUP.

Hamilton Creek is a tributary of Prospector Creek, about 10 miles east of Glenroy homestead.

The group includes the following, which have been taken up since my visit to the district:—

Brideson's "Manxman" (M.L. 695), 10 ac.

Kennedy's "Mount Olive" (M.L. 674), 10 ac.

Brown's "Gipsy's Warning" (M.L. 682), 10 ac.

Smith's "May Queen" (M.L. 683), 5 ac.

Yamamilla (M.F. 2885).

Location, Etc.

The Yamamilla is located on the head of a creek of the same name, within the catchment area of the Dugald River. It, however, is really in the upper Prospector Creek group of ore-bodies.

Its area is 20 ac.

Literature.

For title of reports, numbered as below, see Introduction.

(4) Mr. Cameron wrote of the freehold:

. . . It shows an enormous reef of white quartzite running through the property in a north and south direction, and forming the backbone of the ridge through which Yamamilla Creek cuts near the northern boundary. The outcrop thus exposed stands out as a solid wall running down to the spur of the ridge some 20 feet high and 15 feet across. The face of the wall is cavernous, and stained green with copper salts. It shows the reef to consist of broken fragments of quartz cemented together by secondary silica, and with copper carbonate scattered through it. A sample of some of the best ore gave a return of 9·9 per cent. of copper, a trace of gold, and 3 oz. ·7 dwt. of silver per ton. There does not appear to be any great body of ore present on the surface, and the lode evidently gets poorer as it is traced to the south. The quartzite on the whole has a very hard and barren appearance, the patches of ore being detached and comparatively scanty. The rich colouring of the surface of the lode is easily explained by the readiness with which copper is dissolved out and distributed by water, the colouring being in many instances merely a coating of carbonate on the lode material.

Lease No. 159 is taken up on the continuation of the quartzite beds in the Yamamilla. It does not show much indication at present of being rich in copper.

(7) Mr. Rutherford states:

It is taken up to include a quartz outcrop running north and south in a country of quartzite. The northern end has been cut through by a creek, which shows that in depth the outcrop splits into two branches. Forty feet above the level of the bed of the creek and south from it, the outcrop shows as a mass of quartz 15 feet high and 17 feet wide, stained with carbonate. To the north this blow splits into two branches, running for a distance of eighty yards to the creek and showing for some distance beyond. These branches, like the rest of the outcrop, are composed of blocks of quartz cemented together and showing carbonate stains in joints. They become narrower and poorer in depth as the hill is descended, and in the bed of the creek show from 1 to 2 feet wide with few stains. Continuing the blow to the south it is found to bifucrate also in this direction. The eastern branch can be traced only for a few yards, but the western branch is marked by a fairly well defined line of quartz running into "Mount Hood" (Lease No. 159, 20 acres), adjoining to the south. This southern part of the outcrop is much less stained with carbonate than the large blow. This is not a true outcrop, but a deposition of silica containing copper along the bedding of the altered sandstone. The vivid green colour is due to a thin coating of the rock, and a bulk assay right across the quartz would not show more than a trace of copper.

PROSPECTOR CREEK.

Prospector Creek runs northwards from near the head of the Dugald to the large east and west stretch of the Leichhardt River.

Only five groups are here mentioned, but they do not include every show in this part of the district that has been tried at one time or another.

The creek drains a wide flat-bottomed valley, fairly well timbered with stunted box, with bunches of gidia and bloodwood in the lower part.

MOUNT METALLIC GROUP.

This group is on the western side of the creek, about 3 miles north of the Camooweal road. Included in it here are several holdings lying to the west and south-west not visited by me.

The country is characterised by the presence of much limestone, in which, however, no trace of fossils can be detected, for the region has undergone considerable metamorphism. In the vicinity of where the miners camp at the White Gorge, within a mile to the north of Mount Metallic, the limestones are thin bedded and strike north 10° east, and here some small lenses of hæmatite have been developed. Northwards towards the Dreadnought there seem to have been thicker beds of limestone, in which crystalline quartz has been deposited. Ferruginous chalcedony has also subsequently been introduced, replacing most of the limestone and cementing the broken fragments of quartz. Silicification, with consequent induration, has also been particularly intense over whole beds of slate, in which the deposition of silica has been not only in cracks and joints but throughout the body of the rock. The superior resistance to denudation of the resulting rock causes it to stand out as a rampart, often forming the backbone of a hogbacked mountain. By many of the miners the crops are looked upon as caps of huge lodes.

Mount Metallic (R.C. 310).

Mgr., Price.

LOCATION, ETC.

Mount Metallic is located on the divide west of Prospector Creek and 2½ miles north-west of the Camooweal mail road crossing. The hogback on which it is situated converges towards the White Gorge range.

Its area is 40 ac.

DEVELOPMENT.

No. 1 shaft, 10 ft. deep, with opencuts extending 6 ft. south-east and 15 ft. north-west, is a little south of the middle of the claim. Between this and the main (No. 2) shaft, 1 ch. to the north-west, there are two opencuts, 12 ft. and 10 ft. in length and 8 ft. deep. No. 2 shaft is 28 ft. deep and underlies 2 in 1 to the east. No. 3 shaft, 20 ft. to the north-north-west, is 47 ft. deep, and inaccessible. From this

an opencut, 10 ft. deep, continues for 25 ft. northwards. No. 4 shaft is 4 ch. north-north-west of No. 3, and is 20 ft. deep. In addition to these workings there is an opencut, 10 ft. deep, running for 30 ft. west-north-west from the opencut at No. 3 shaft.

OUTPUT.

Prior 1906	...	45 tons shipped, carrying 35% copper (*fide* Mr. Price).
1906	...	25 ,, ,,
Total	...	70 ,, ,,

ORE-BODIES.

The crop, at the south-east, comprised cellular limonite, with melaconite (?) and malachite lining cavities. The ore-body, in the No. 1 shaft and the adjacent opencuts (where, however, there are strings in the footwall for 12 in. from the ore-body), is only 6 in. wide. But the limonite there carries chalcopyrite, enriched by chalcocite, while a little jagged (crystalline?) native copper has been found, embedded in cuprite, which gradually shades off into limonite, mammilary on cavities. There is now 15 cwt. of native copper and cuprite at the shaft. The strike of the lode here is north 28° west, its inclination being almost vertical. The country rock is a siliceous cherty slate.

Very little ore can be seen in the northern end of No. 2 shaft, but the seam, dipping 2 in 1 eastwards, on the southern end averages 12 in., of which the 4 in. on the hanging-wall is chalcopyrite enriched by chalcocite, while the remainder is a siliceous skeleton with a little crystalline malachite. The copper ore is increasing somewhat towards the bottom, where tile-ore is also appearing. The walls here are well defined, but show no slickensides, though irregular polished vertical faces occur for 2 ft. 6 in. from the ore in the footwall country, which for that distance is gossany and cellular (probably owing to leaching), and is to be looked on as a formation, in which copper may appear at any time. There is 1 ton of ore bagged at the shaft, consisting chiefly of an intimate mixture of chalcocite and malachite. My sample (35/B) was taken from one of the bags at No. 2 shaft. It consists of limonite, with malachite disseminated and filling cavities and cracks, with an impregnating glance, and with sporadic crystals of pyrite; of massive glance with scattered crystals of pyrite and coats of malachite on cracks; of earthy malachite, accompanying kaolin; and a very little secondary quartz, drusy in cavities in the limonite, but there is no original quartz present. One specimen consists internally of reddish limonite, containing a few specks of pyrite and surrounded by crystalline glance, on which is an external coat of drusy malachite. The sample assays (Government Analyst):

Copper	... ...	39·8%.
Gold	... ...	Tr.
Silver	... ...	1 oz. 16 dwt. per ton.

It is reported that there is 2 ft. of ore in the bottom of No. 3 shaft, but, in the end of the opencut to the north, the width is only 9 in. The country here appears to be strikingly obliquely to the ore-body.

The practically vertical streak of rich ore, beside 3 or 4 in. gossany kaolin, in No. 4 shaft is only 1 to 3 in. thick, except at the bottom of the shaft, where the gossan is 12 in. wide at the northern end. The eastern slate wall in places is very well defined, and, if followed, may lead to a bunch of ore. The 2 tons bagged at the shaft comprise siliceous tile-ore and chalcocite-chalcopyrite, and are expected to yield 30% copper.

The cut west of No. 3 shaft exposes 3 to 6 in. gossan, which, though in the cut reported to be 2 ft. wide in places, appears to follow a west-north-west striking joint, dipping 6 in 1 to the north-north-east. The walls are strong, but the hanging-wall country is altered for 18 in. from the ore, and is very gossany. The gossan can be traced for several chains to the west of the cut.

The Mount Metallic country would seem to be on the continuation of that on which is the Dreadnought, and though no limestone was seen on the claim it is known to occur on the hill to the south.

Queenslander (M.L. 436).

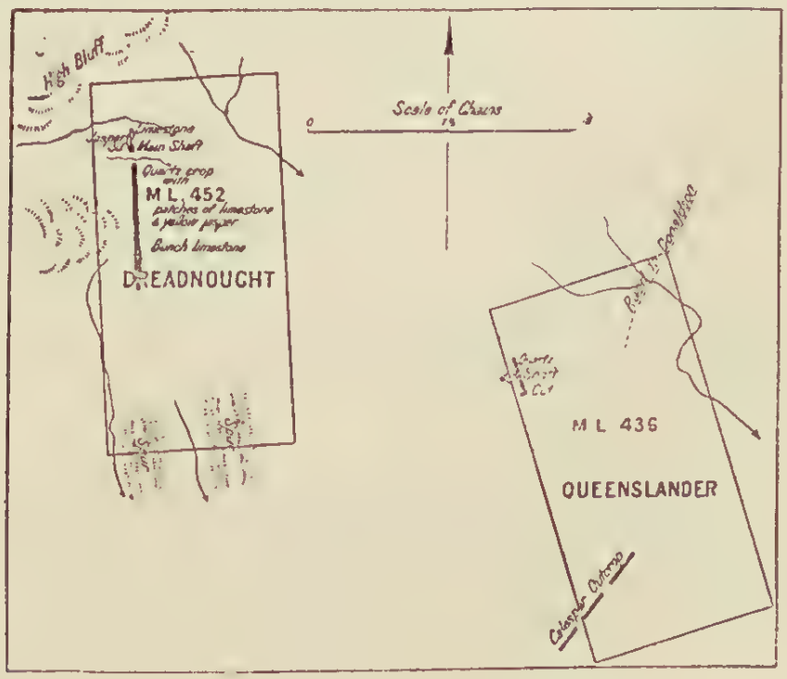
Mgr., Price.

Location, Etc.

The Queenslander lies north 33° east from Mount Metallic, at a distance of 1½ mile.

Its area is 20 ac.

Only one shaft and a pothole have been sunk on this lease, the former to a depth of 45 ft., and the latter 6 ft. A drive is being carried southwards from the shaft bottom.



Output.

	4	tons	shipped,	carrying	35% copper.
	6	,,	,,	,,	22½% ,,
1906 ...	7	,,	,,		
Total	17	,,	,,		

Ore-bodies.

The ore-body appears to run south 25° east from the main shaft, and traces of copper can be found for nearly a mile in that direction, but exposures are few and far between. Quartz fragments are scattered over the surface for 40 ft. north of the shaft.

At the main shaft the crop is a somewhat gossany and copper-stained material, which passed at 32 ft. depth into a sintery formation, carrying bunches of copper ore, yellow jasper, and brown calcite, 15 in. wide at the northern end and 3 ft. wide at the southern. The footwall, on which there is 6 in. of crushed lime-bearing slate, is well defined, and dips 1 in 4 to the east-north-east, but no hanging-wall can be distinguished. Bunches of rich ore have been found in the drive for 8 ft. from the shaft, especially about 2 ft. from the footwall. Some 10 tons of ore have been shipped from this shaft, there are 25 tons of seconds, carrying 16% to 18% copper, at grass, and the whole tip will carry between 5% and 10% copper. The last 1½ ton of ore raised, and waiting to be sorted, should yield 28% copper. It consists of chalcopyrite, intimately associated with chalcocite, a little earthy lime, and quartz, and shows some stains of malachite. The same quantity of firsts, paddocked and comprising nearly pure chalcopyrite-chalcocite ore, is expected to assay 48% copper.

The pothole is on a cupriferous, slightly gossany formation, 18 in. wide at the northern end but only 7 in. wide at the southern. In all, 4 tons of 28% ore have been shipped, and there are 5 tons of seconds (5% copper) at grass.

Too little can be seen of the crop for any more favourable statement to be made than that continued sinking is advisable, with the simultaneous opening of costeans. Water level is to be expected at about the 70-ft. level.

A small crop of limestone was seen about 5 ch. north-east of the workings.

Just outside the Queenslander, to the west, is a north and south vertical vein of calcite up to 18 in. in thickness, from the surface of which a few tons of ore have been collected and bagged.

There is also an old shaft, 15 ft. deep, about 10 ch. south-west of the north-western corner peg of the lease. It is on a formation,

12 in. wide at the surface, in schist, dipping 70° to the south-west, and traceable for 3 ch. to the north-west. Only 2 tons of 24% ore have been taken from here.

Dreadnought (M.L. 452).

Mgr., Donner.

Location, Etc.

The Dreadnought, formerly held as M.L. 115, lies ¼ mile west of the Queenslander, and ½ mile north-north-east of the White Gorge.

Its area is 20 ac.

A shaft has been sunk, 4 ch. south-east of the north-western corner peg, to a depth of 30 ft., and a contract was let at the end of 1906 to continue the shaft to a total depth of 67 ft. It is proposed to cross-cut east and west at the 50-ft. level.

Ore-bodies.

The main outcrop, in which is the shaft, consists of limestone, replaced by silica and limonite, some of which is very cellular. It is 40 ft. in length and perhaps 15 ft. wide, though boulders of the rock are spread over a width of 30 ft. Interesting specimens are here available of ferruginous, granular quartz, pseudomorphous after calcite, as proved by a well-marked rhombohedral cleavage exhibited.

The sinking in the shaft was silicified limonite or ferruginous jasper, the 35 tons of which at grass will probably run 3% copper, but are valueless because of the very high silica content. The lower part of the shaft is just passing into soft kaolinic formation, which, however, contains no copper. The limonite is in bands, which dip 60° to the west; that at the 14-ft. level contains bunches of pyrite as well as copper stains. Sinking and cross-cutting appears to be justified.

An area of limestone, 10 ft. in diameter, is to be seen on the northern side of the ferruginous crop, and, 20 ft. south of the shaft, there is a crop of barren quartz, showing some patches of limestone, silicified limestone, and silicified limonite. This crop is 7 ch. in length and up to 15 ft. in width.

Other irregular crops of limestone occur 10 ch. south of the Dreadnought. There are also areas, up to 40 ft. and even 50 ft. wide and 4 ch. long, of "pudding-stone," consisting of angular quartz cemented by a ferruginous chalcedony (silicified limonite), beneath which copper ores may be found.

Kangaroo (P.A. 261).

Mgr., Price.

LOCATION, ETC.

The Kangaroo lies 4 miles west of the Mount Metallic.

Its area is 40 ac.

There is one opencut 30 ft. long and 16 ft. deep.

OUTPUT.

4 tons trial shipment, 22% copper.

Great Northern (P.A. 242).

Mgr., Price.

LOCATION, ETC.

The Great Northern lies 5 miles north-north-west of Mount Metallic.

Its area is 20 ac.

Only cuttings have been opened, and no ore has been shipped.

ORE-BODY.

Mr. Price reports an outcrop showing ironstone and limestone, over a width of 80 ft., running for ½ mile, and rising in places 50 ft. above the flats.

Lady Ethel Florence (P.A. 265).

Mgr., Price.

LOCATION, ETC.

The Lady Ethel Florence is 2 miles west of the Great Northern.

Its area is 160 ac.

Only shallow cuttings have been made here.

OUTPUT.

4 tons trial shipment, 22% copper.

Mount Joseph (P.A. 288).

Mgr., Turner.

LOCATION, ETC.

Mount Joseph is 6 miles north-west of Mount Lucas, at the head of Middle Creek.

Its area is 40 ac.

OUTPUT.

1906 ... ... 4 tons shipped by J. Turner. Source doubtful.

Mount Lucas (P.A. ?).

Mgr., Turner.

LOCATION, ETC.

Mount Lucas is on the Bowerbird road at the head of Bora Creek, and within 2 miles of Mount Cubrabunia.

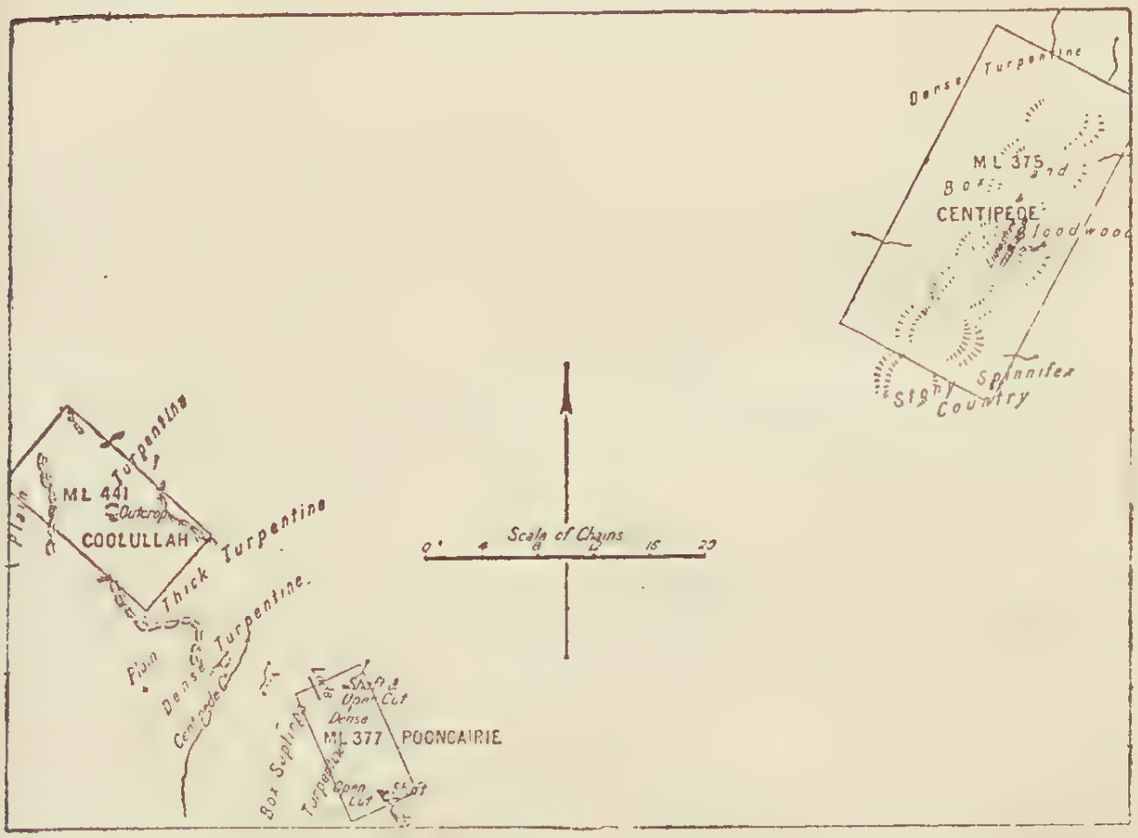
Its area is 160 ac.

OUTPUT.

1906 ... ... 2 tons shipped (T. Turner, Mount Remarkable).
7 ,, at grass, carrying 30% copper.

CENTIPEDE GROUP.

This group comprises four leases in the vicinity of the junction of Prospector Creek with the Leichhardt River. None of them had been



worked for a considerable time, and it was found possible to locate only the Centipede in the time available.

On the Coolullah (M.L. 441) and Emerald Hill (M.L. 440) no work has been done.

Centipede (M.L. 375).

Location, Etc.

The Centipede is located within the catchment area of the creek of the same name, 5 miles south from the junction of Prospector Creek with the Leichhardt River. This is in a region of broken gullies and low hills, extending for miles to the south-east from the Prospector Creek flood plain.

The area of the lease is 28 ac.

Literature.

For title of report, numbered as below, see Introduction.

(4) Mr. Cameron wrote:

The Centipede is a lenticular bed of limestone at the southern end, containing copper disseminated in particles through it. Two trenches have been put into it on its western side, but do not disclose ore of any great prospect. Further north the limestone is replaced by silica, and shows some likely-looking patches of cupriferous material.

Development.

The lease had long been deserted, and was only found after long search by my blackboy. There is one trench 15 ft. long, and 15 ft. west of it is a shaft, 35 ft. deep, from the bottom of which, it is said, a crosscut runs 18 ft. to the east. Other trenches have been made 10 ch. to the south-south-west.

Ore-bodies.

To the north-east of the lease many north and south belts of siliceous limestone were observed in slate and schist country. The limestones towards the west have lumps and veins of quartz segregated in them, and occasionally quartz is found to replace the whole width of a bed over a distance of from 1 to 5 ch. and a width of up to 1 ch., when they often rise 50 ft. above the general level of the ridges. In the vicinity of the lease bunches of gossan and traces of copper are also found.

The trench has been opened in a ferruginous crop of limestone, 15 ft. wide, which strikes north-north-east and dips 70° westwards. It exposes only 4 ft. width of quartz and siliceous copper-stained limonite in limestone. Very small splashes of chalcopyrite and erubescite were noticed in the solid quartz, and of chalcopyrite in the limestone, from which a little malachite weathers out. There are 2 cwt. of green-stained limonite at grass which may yield 2% copper.

The shaft has been sunk to prove this body at a depth. The upper part is in friable slaty rock, and at 30 ft. from the surface siliceous and ferruginous limestone, carrying only slight stains of copper, has been struck. No further work is warranted here.

The southern workings are in a big blow of ferruginous limestone, carrying very little silica (chiefly crystallised in cavities) and only stains of copper. Occasional specks of chalcopyrite were noticed in the limestone, and pseudomorphous crystals of limonite after chalcopyrite weather out on the surface.

Pooncairie (M.L. 377).

Location, Etc.

The Pooncairie lies ¾ mile west-south-west of the Centipede.

Its area is 5 ac.

Mr. Cherry has stated that a shaft has been sunk 75 ft., and that a drive runs west for 42 ft. at the 55-ft. level.

Literature.

For title of report, numbered as below, see Introduction.

(4) Mr. Cameron reported:

The Pooncairie Lode lies about 3 miles south of the junction of Prospector's Creek and the Leichhardt River. It shows an outcrop of siliceous rock running parallel to the bedding of the north and south striking talcose schists. A trench across it exposes about 10 feet of lode material carrying oxide of copper in irregular seams, and lining the vughs in the rock. A shaft about 16 feet from

the eastern wall of the lode is down 35 feet, and a drive to the west just above the water-line has passed through 18 feet of the siliceous outcrop. Mr. Green, who visited the locality some months after our first visit, says that the siliceous rock does not contain the same amount of copper in the drive as on the surface. The lode is apparently secondary silica dissolved out from the schists on either side, and has become impregnated with copper leached out also from the country rock.

ORE-BODIES.

Ruby ore is said to have been found here, but no mention is made of any body of ore, the shaft being sunk in soft country.

SURPRISE GROUP.

The group is located in the rather inaccessible mountainous country between the Pinnacles and Prospector Creeks.

No particulars are available of the Surprise* (M.L. 261), Surprise South† (M.L. 262), and Mount Ferrum (M.L. 443), of which the first two are 5 miles north-east of Mount Metallic, and the last is within a mile north of the Pinnacles waterhole on the Camooweal road, midway between Cabbage-tree and Prospector Creeks.

Jumbo (M.L. 442).

Mgr., Power.

LOCATION, ETC.

The Jumbo adjoins the Surprise on the north-west.

Its area is 30 ac.

ORE-BODY.

Mr. Cherry, in 1903, reported here "a very large and continuous quartzite outcrop . . . which shows traces of carbonates."

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* The manager of the Mount Cuthbert reported late in this year (1907) that a well had been sunk as well as an underlie shaft 28 ft. deep, on a promising lode.

† The manager reported in October, 1907, that a costean had been put across the lode showing it to be 12 to 14 ft. wide, and to consist mostly of gossan and siliceous iron, copper stained.

LEICHHARDT RIVER.

In speaking of the Leichhardt River mines those on the big bend are always meant, as otherwise it would be necessary to include a region nearly 100 miles in length. The groups included are the Mount Cuthbert, Mighty Atom, and Jessie's Dream, practically all within the catchment of Six-mile Creek.

Schists, with lenticular beds of limestone and huge outcrops of quartzite, are characteristic of the eastern portion of this district, but westwards porphyritic rocks are present in great abundance.

MIGHTY ATOM GROUP.

The mines of this group are almost all located in the flat-bottomed valley drained by St. Paul's Creek (running northwards) and Six-mile Creek (running southwards). The surface is covered with angular quartz and ironstone gravel, and carries only a thin sprinkling of stunted mountain gum and spinifex.

The country is similar to that within the Prospector Creek catchment in showing crops of bedded limestone replaced to a greater or less extent by quartz and accompanied by some copper ore, quite possibly precipitated by the action of the lime.

A note may be made here of the rumoured occurrence of alluvial gold, at the head of Copper-mine Creek, within a few chains to the north of the Mighty Atom. Mr. McKeand reports colours to be well distributed, and on one occasion discovered a 1½-dwt. slug. We are unable to do any prospecting, as the gullies were dry.

Mighty Atom (M.L. 274).

Mgr., McKeand.

Location, Etc.

The Mighty Atom is located on the divide between the Six-mile and Copper-mine Creeks, at the head of the eastern branch of the former.

Its area is 20 ac.

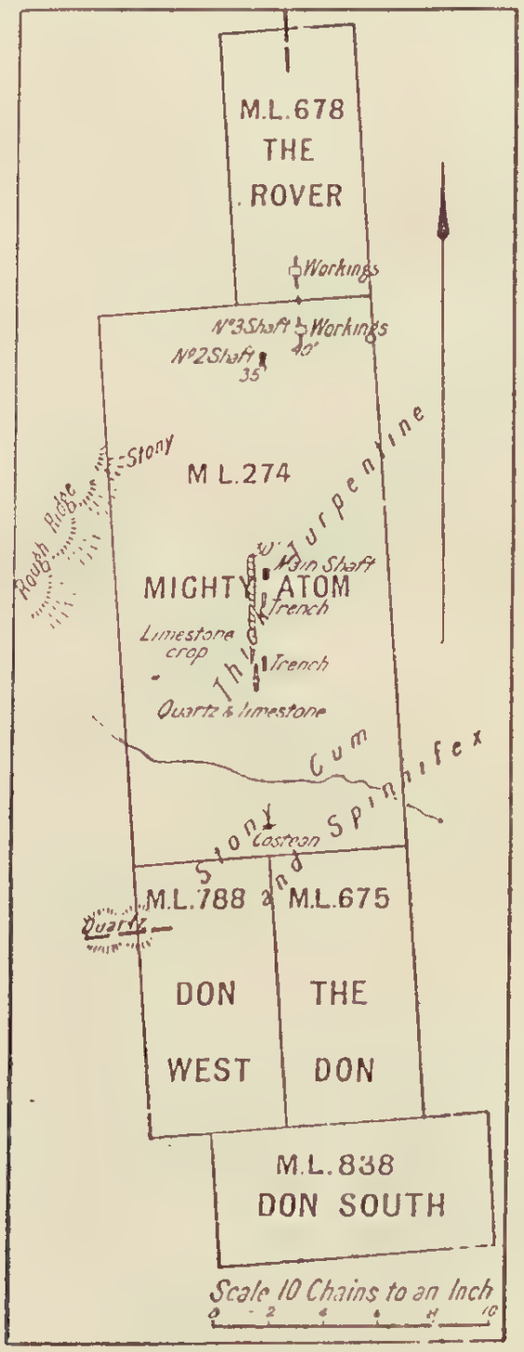
Development.

A costean, 40 ft. long, 6 ft. wide, and 3 to 5 ft. deep (near the middle of which is a caved-in shaft, 15 ft. deep), is 1 ch. north of the centre of the southern boundary. At 6 ch. to the north there is a trench; 2 ch. beyond that there is another trench, 10 ft. long and 5 ft. deep. No. 1 shaft, which is 30 ft. deep, and in a state of collapse, lies 1 ch. further north. About 4 ch. north of No. 1 shaft there are two trenches, and 4 ch. beyond them is No. 2 shaft, underlying 1 in 1 and 35 ft. deep, but falling in. No. 3 shaft, 40 ft. deep and inaccessible, is 1 ch. to the north-east of No. 2 and 3½ ch. from the north-eastern corner peg.

The workings, which are the result of the Melbourne Coolullah Option Syndicate's tenure, have been so long (about six years) standing that the exposures in them are of little use.

Output.

18 tons shipped, carrying 24½ to 43½% copper.



Ore-body.

The Mighty Atom workings lie along, or adjacent to, the outcrop of a bed of quartz-veined limestone, replaced to some extent by iron and silica.

For 5 ft. east and 5 ft. west of the shaft in the southern costean, the country (soft schist or slate) is more or less cupriferous, the mixed azurite, malachite, glance, and tile-ore occurring in small irregular masses with a little chrysocolla. There is no defined ore-body, but,

just east of the shaft, there is a band, 18 in. to 2 ft. wide, of more richly cupriferous and ferruginous country, which dips 85° to the east 5° north. Possibly payable, but low-grade, schist will be found below. Only 5 tons of 39% ore have been shipped from here, but there are 15 tons of seconds at grass, chiefly kaolinised slate, which may carry 10% copper and are almost free from quartz.

Across the gully to the north of the costean there is a crop of gossan and yellow jasper giving way northwards to limestone, alongside of which is the first trench, from which 9 tons of ore, containing 43½% copper, have been shipped. The 3 tons of seconds (malachite and tile-ore in limonite with a little quartz) left, carry 20% copper. Nothing can be seen of the ore now in the trench.

The second trench is on the eastern side of the continuation of the limestone, which is there quartz veined, but nothing can be made out in it. It is said that some soft black gossan was raised, and that 3 tons shipped yielded 24½% copper. There are also at grass 3 tons of siliceous limonite carrying fine-grained tile-ore, glance, and malachite, worth perhaps 5% copper.

Quartz crops 5 ft. west of No. 1 shaft, beyond it there is 5 ft. width of chrysocolla-bearing country, and then 21 ft. width of crystalline limestone, the first 12 in. of which is schistose. The shaft is sunk in limestone and sinter, but 1 ton of ore has been shipped, and there are a few hundredweights of fine-grained, oxidised, 30% ore at the brace. Mr. Keand informed me that 25 tons of 35% ore have been shipped from this shaft and the adjacent trenches, but only a few tons of 20% oxidised ore can be seen at the surface now.

The trenches between Nos. 1 and 2 shafts are in "formation," but no ore is visible.

No. 3 shaft appears to be east of this formation, in mica-schist country. Very little gossan has been raised, though fragments can be picked up on the copper-grass covered surface for 1 ch. to the north, where is a trench on the Rover. In a trench alongside No. 3 shaft 18 in. of ore, dipping steeply eastwards, can be seen, and for this the shaft presumably was sunk.

Rover (M.L. 678).

Mgr., Anderson.

Location, Etc.

The Rover adjoins the Mighty Atom on the north.

Its area is 5 ac.

It had been only just pegged out, when visited at the end of 1906.

One hole, 10 ft. long and 7 ft. wide, was sunk 10 ft. on this ground, before it was pegged out, by the Mighty Atom leaseholders.

ORE-BODY.

The hole exposes country veined with gossan, over a width of 8 ft. at the northern end, and, at the southern end, there are 12 in. width of solid limonite and 18 in. of cellular gossan, underlying 6 in 1 to the east 5° north. The gossan can be traced southwards to No. 3 shaft on the Mighty Atom, and northwards for 1 ch. within this lease. The crop is worthy of further attention, for, though there is little copper at the surface, rich ore is to be expected towards water level.

Mount Millicent (M.L. 663).

Mgr., McDonald.

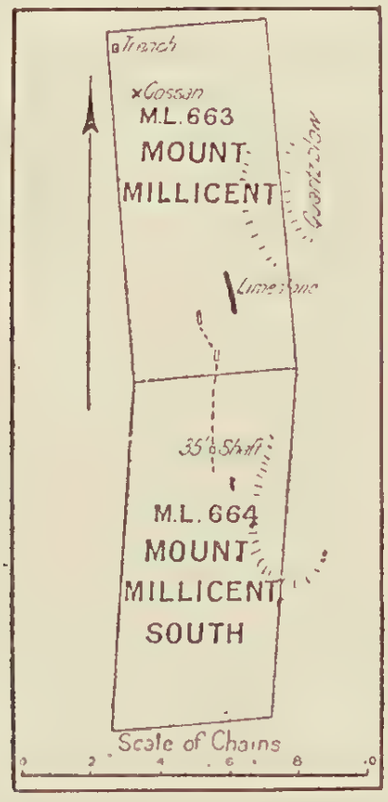
LOCATION, ETC.

Mount Millicent is ½ mile south of the Mighty Atom.

Its area is 5 ac.

DEVELOPMENT.

Only three trenches have been opened on this lease. The northernmost, 12 ft. long and 5 to 8 ft. deep, is in the north-western



corner. Another, 10 ft. deep, is ½ ch. north of the centre of the southern boundary, and the third, 15 ft. long and 5 ft. deep, is 1½ ch. to the north-west of the second.

OUTPUT.

16½ tons shipped, averaging 30% copper

ORE-BODIES.

The country here is schist, but the southern workings are in the vicinity (to the west) of a crop of limestone.

The northern trench is in altered slate country, on a bunch of siliceous, oxidised, chalcocite-bearing ore, from which 2½ tons of 30% ore were bagged.

There is a small crop of very promising cupriferous gossan, worth opening up, 2 ch. south-east of this trench.

Bunches of pure cuprite were found on the surface, where is now the southernmost trench, in the northern end of which can be seen 15 in. cupreous limonite, though at the southern end there is only 9 in. width of soft ferruginous clay. In the middle of the cut 6 to 12 in. width of chalcocite-bearing carbonate-oxide ore is exposed, and is worth sinking on. The ore-body dips 10 in 1 to the east, and is bounded by schist, strongly foliated, on the west. In all, 12 tons of medium-grade ore have been shipped from this trench, and there are at grass 2 tons of ferruginous but quartz-free malachite and chalcocite tile-ore, expected to yield 30% copper. This body can be traced for ½ ch. to the north, when it probably bends round towards the central trench.

In the third trench is to be seen a 6-in. sandy, ferruginous seam, with a general north-north-west strike, but bending round towards the south-east at the southern end. Stacked alongside there is ¾ ton of siliceous oxidised ore (quartz-bearing limonite with chalcocite-enriched chalcopyrite having acicular malachite in cavities) containing between 15% and 20% copper, and 50% silica.

It is 1 ch. to the north-east of this trench that the brownish granular limestone crop, referred to, begins. The bed is 1½ ch. in length and 12 ft. wide near the centre.

Mount Millicent South (M.L. 664).

Mgr., McDonald.

Location, Etc.

This adjoins the Mount Millicent on the south. It is 1 mile north-east of McDonald's Camp on Six-mile Creek, and within a few chains to the east of the Mighty Atom track.

Its area is 5 ac.

Development.

The workings are in the northern part of the lease, the shaft, which is 35 ft. deep, being 3 ch. south-east of the north-western corner. An opencut, 10 ft. deep, extends for 20 ft. north of the shaft, and, 12 ft. to the south, there is a trench, 4 ft. deep. The only other openings are a few potholes 1 ch. north of the main shaft.

Ore-bodies.

Shoads of ore are found on the surface, between the workings on this lease and those on the Mount Millicent, and, in the northern end of the opencut a 6-in. vein of ore is visible within 2 ft. 6 in. of

iron-stained country, beyond which the slate is kaolinised and bleached. The hole south of the shaft is being opened in kaolinised slate alongside a band of gossan.

The shaft is sunk in kaolinised slate with iron-stained joints and very occasional bunches of copper ore. A drive to the north had just been begun, and already bunches of mixed tile-ore and crystalline malachite, as well as of mixed limonite-chalcopyrite-malachite, embedded in kaolin, were being met, warranting the continuation of the drive. There is stacked at the shaft 3 tons of chalcocite-enriched oxidised ore, likely to yield 50% copper, and very low in silica; and in addition there is 1 ton of chalcopyrite-chalcocite ore of 30% grade.

To the east of the Mount Millicent leases there is a low quartzite ridge.

Mount Bornite (M.L. 376).

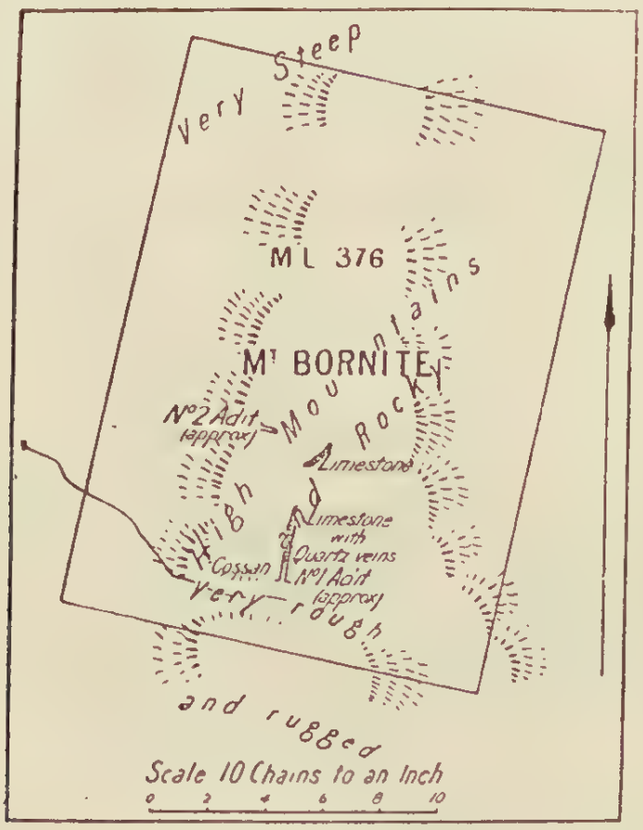
Mgr., Power.

Location, Etc.

The Mount Bornite lies 1 mile south-west of the Mighty Atom, and 1½ mile north of McDonald's camp on the Mount Cuthbert track, being on the steep western slopes of the hill of the same name.

Its area is 30 ac.

Two adits have been opened on this lease: No. 1, near the southern



boundary, is 100 ft. in length; and No. 2, 5 ch. to the north-north-west, is stated to be also 100 ft. long, but has now fallen in.

Ore-bodies.

The country rocks in this vicinity comprise breccias, schists, quartzites, and limestones, having a general north and south strike.

Gossan shoads are very abundant on the steep slopes below No. 1 adit, and most of them have presumably been shed from the ferruginous crops of the limestones, in one of which is the No. 1 adit. Just above the adit it has the appearance of a siliceous gossan, up to 6 ft. in width and of some promise. This continues for a distance of 25 ft. to the north, where it gradually passes into quartz-bearing limestone, in which the amount of quartz diminishes to a negligible quantity, about 1 ch. from the adit. This bed of limestone cuts out at 2½ ch. north of the adit, but a second crop appears 1½ ch. further north. This is also veined with quartz, and contains small patches of copper ore. The crop is irregular in shape, as is not unusual in organically derived limestones. Slight copper stains were noticed still further to the north.

No. 1 adit was opened in schistose slate, but after a few feet enters and runs northwards in bluish, silky crystalline limestone. The limestone contains numerous gash veins of barren quartz and in the adit is very cavernous, the spaces being very often partly filled with gossan. The iron content of the rock is very high, and a complete chemical analysis would probably prove it to approximate to ankerite. In all, 4 tons of this gossan have been collected and stacked at the mouth of the adit. It contains much chalcopyrite, in process of conversion externally into chalcocite, together with a little malachite and tile-ore, and the proportion of silica is over 50%, the copper present being not above 15%. There is no justification for continuing the adit, but ore may be found adjacent to the limestone on the east, and a crosscut might therefore be opened in that direction.

No. 2 adit was put in to test the northern limestone crop, but failed to find the bed.

Little Wonder (M.L. 258).

Mgr., Power.

Location, Etc.

The Little Wonder lies ½ mile east from the Mighty Atom.

Its area is 5 ac.

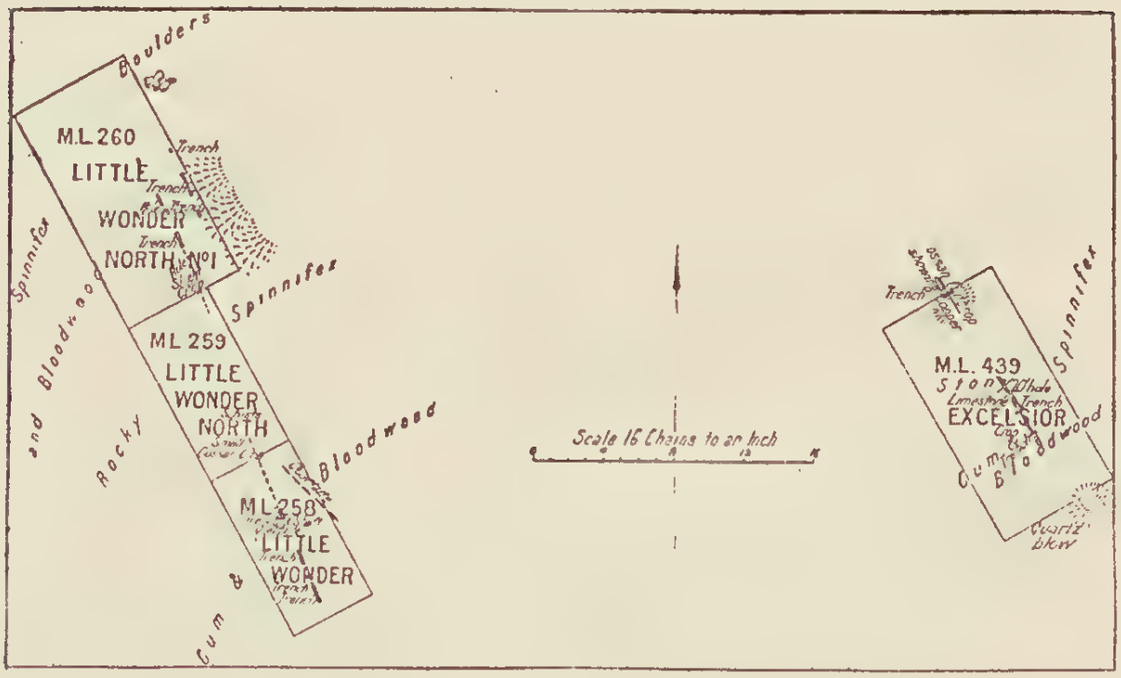
The lease is now held by the Mount Cuthbert Company, the crop having been discovered in 1896.

Development.

A trench, 20 ft. long, with a 15-ft. shaft in the centre, lies 3 ch. south-south-west from the north-eastern corner; 5 ft. to the south of it is a shallow hole; 1 ch. beyond is a trench, 50 ft. in length, but caved in; and 1 ch. beyond it is another trench, 20 ft. long and up to 6 ft. deep, but in the same state. Running north-west from the last is a trench, 30 ft. long, full of water when seen; and 10 ft. to the south are trenches, 1½ ch. long, now filled with water.

Output.

Total ... 45 tons shipped, averaging 40% copper (*fide* Mr. McKeand).



Ore-bodies.

Mr. McKeand, the prospector, states that the ore-bodies trenched made no crop, but that shoads of native copper and cuprite, from lumps the size of a potato up to 28 lb. in weight, were abundant on the surface. It is so long since any work was done here that little or nothing can be made out of the occurrence of the ore.

The country rock is schist with converging bands of quartzite, their lack of parallelism being probably due to folding of the strata.

The northern trench and shaft now show only a 6-in. seam of ore, dipping 2 in 1 to the east. The ore is said to have been 2 ft. wide in places. Small lumps of native copper, surrounded by concentric coatings of cuprite, can be picked out of the tip.

A little chrysocolla was noticed in the limonite thrown out of the hole to the south.

Much cuprite can also be found in the north-north-west-running trench, which, though diverging from the main line of workings, is parallel to many of the quartzite crops in this vicinity.

Little Wonder North (M.L. 259).

Mgr., Power.

Location, Etc.

This adjoins the Little Wonder on the north.

Its area is 5 ac.

One small trench only has been opened on this lease, and that is 1 ch. from the north-eastern corner.

ORE-BODIES.

The trench is on the line worked in the No. 1 North. It exposes cupriferous gossan, worth further opening up, though probably a bunch.

Another small crop of gossan is to be seen in schist 2 ch. from the south-eastern corner. This is on the line worked in the Little Wonder.

Little Wonder North No. 1 (M.L. 260).

Mgr., Poole.

LOCATION, ETC.

This is separated from the Little Wonder by the North (M.L. 259). Its area is 10 ac.

DEVELOPMENT.

A line of holes extends along the whole of the eastern side of the lease. The northernmost hole (i.), which is 10 ft. deep, is in the gully 5 ch. from the northern boundary. A trench (ii.), 30 ft. long, is 2 ch. to the south, and a 10 ft. hole (iii.), now fallen in, lies 15 ft. further south. At 1 ch. beyond it is a trench (iv.), 50 ft. long, and ½ ch. south of it is a shallow trench (v.). Besides these there are three openings on the eastern boundary line. The central one (vi.), which is 1½ ch. long and 10 ft. deep in one part, is 1 ch. east of the 50 ft. trench (v.). At 1½ ch. to the north there is a shallow trench (vii.), and 1 ch. to the south is a trench 25 ft. in length (viii.).

OUTPUT.

4 tons shipped.

1906 ... 16 ,, ,, (McKeand).

ORE-BODIES.

The country rock adjacent to the ore-bodies, which would appear to consist of a number of small bunches, is schist, but at the northern end quartzite occurs to the east and limestone to the west, and further south, between the two lines of workings, there is a crop of pseudo-amygdaloidal rock (highly altered sedimentary?).

Little can be seen in the northernmost workings, but there is a little gossany carbonate ore at grass, similar to some shipped, which was found associated with "floors" of sinter.

The trench (ii.) exposes chiefly quartz rubble in mica schist, and hole (iii.) was probably on a bunch of ore.

The long trench (iv.) was presumably opened on small irregular bunches of ore in schist, but now nothing but 18 in. ferruginous formation at the northern end is visible.

Copper-bearing limonite, 18 in. across, is to be seen in trench (v.), and some native copper has been got here. A slight crop can be traced from here to the trench in the north.

The long trench (vi.) revealed irregular and ill-defined bodies of oxidised ore, of which 4 tons have been shipped.

A small bunch was found in the trench (vii.) to the north, and another occurred in that to the south, now showing only chloritic schist, with 9 in. width of siliceous gossan at the northern end.

Excelsior (M.L. 439).

Mgr., Power.

Location, Etc.

The Excelsior is situated ½ mile east of the Little Wonder.

Its area is 10 ac.

Four costeans have been opened on this lease. One on the centre of the northern boundary is 20 ft. in length and 8 ft. deep; a second, 7 ch. to the south-south-east, has a hole in one end 20 ft. deep; a third, 50 ft. beyond, is 20 ft. long and 12 ft. deep near the centre; and the fourth, 1½ ch. on, is 20 ft. long and 5 ft. deep.

Ore-body.

This lease takes in a crop of limestone, ferruginous in parts, and showing occasional slight stains of copper, but unlikely to carry payable copper ore.

The first costean is in yellow, cherty, replaced limestone, beneath which a little copper may be found. The second costean is in limestone, with abundant dendritics but no sign of copper. The third is in white sinter (amorphous calcium carbonate) with some cherty jasper adjacent to the limestone, which here dips 3 in 1 to the east-north-east. Copper plant is abundant, but the mineral is present in only small quantities. The fourth costean is in rather gossany and sintery limestone, not worthy of further attention.

On the line of these crops, a few chains south-south-east of the lease, a blow of quartzite rises 70 ft. above the general level of the country.

Merrie Monarch (M.L. 378).

Mgr., McKeand.

Location, Etc.

The Merrie Monarch is situated 2 miles north of the Mighty Atom, and really should be placed in a separate group.

Its area is 5 ac.

Output.

1906 ... ... 16 tons bagged.
4 ,, shipped.

ORE-BODY.

Mr. McKeand states that on this lease there is a formation similar to the Mighty Atom. It is 5 ft. wide, and can be traced for about 1½ ch. in a north-north-easterly direction.

JESSIE'S DREAM GROUP.

One lease only had been taken up here in 1906.

Jessie's Dream (397).

Mgr., Reid.

LOCATION, ETC.

The Jessie's Dream is just on the edge of the hilly country west of the Leichhardt River is 4 miles south-east by east of the Mighty Atom, and is 60 miles north-north-west of Cloncurry.

Its area is 5 ac.

Mr. McKeand informed me he had sunk a hole 15 ft.

OUTPUT.

3 tons shipped, carrying 45% copper.

ORE-BODY.

The outcrop is stated to be of siliceous ironstone. The pit is on a formation, 2 ft. 6 in. in width, carrying bunches of red oxide and native copper adjacent to the ironstone.

MOUNT CUTHBERT GROUP.

Eight leases are in force here, the total area being 194 acres. They extend along the eastern side of a north and south trending range, in a belt of schist, which at the Kalkadoon has a width of 5 ch. This belt requires thorough examination, and might in many parts be tested by adits, especially to the north of the leases.

The Kalkadoon workings are on a distinct zone to those on the Mount Cuthbert proper, which runs several chains to the east of the former, there forming a low crop in one place at least. There is some justification for believing that the two belts are opposite legs of a sharp anticline.

To the east of the Mount Cuthbert group there is a great development of crystalline metamorphics, with belts of porphyry, similar to the rock so characteristic of the Dobbyn group.

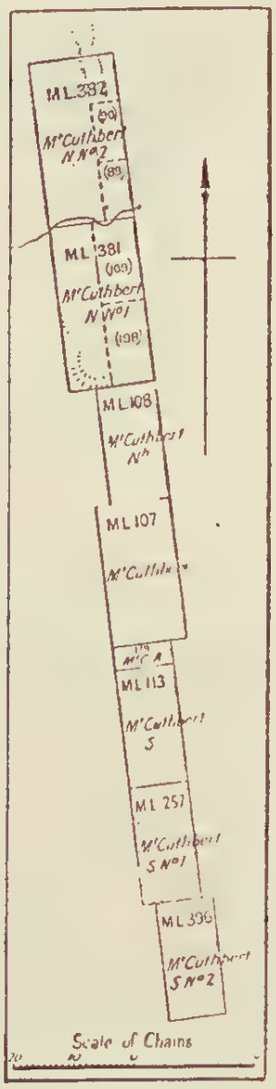
No work has been done on M.L's 382, 113, and 179, which are consequently omitted.

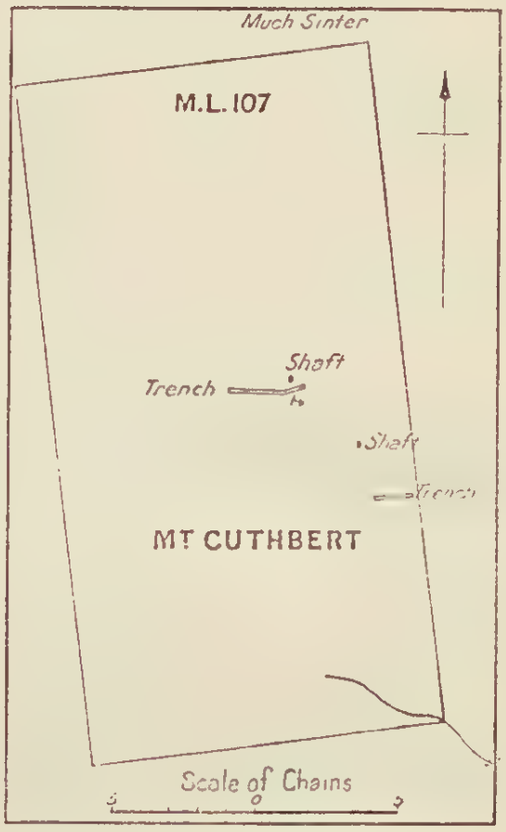
Mount Cuthbert (M.L. 107).

Mgr., Power.

Location, Etc.

The Mount Cuthbert lease lies in the valley of one of the head branches of the Six-mile Creek, 19 miles south-west of Coolullah H.S.,





and 63 miles north-west from Cloncurry. A dray track connecting with the main Camooweal road at the Cabbage-tree mail change has now been open for some time.

The area is 30 ac.

Development.*

An old hole (*a*), 10 ft. deep, lies near the eastern side, 10 ch. from the south-eastern corner; and, ½ ch. to the west-south-west, there is a trench (*b*), 10 ft. long and 4 ft. deep.

The main cutting† (*c*), 2½ ch. north-north-west of this, has a total length of 196 ft., the first section, 10 ft. deep, being 62 ft. long and

* From the manager's reports, published in the Press prior to 5th November, it is learnt that the new or main shaft has been sunk to a depth of 178 ft. in mineralised schist, and that 300 gall. of water per day at 106 ft. depth increased to 2,000 gall. per day at 145 ft. depth. Further a crosscut running 58 ft. east from the whip shaft at the 80-ft. level proves the following sections:—Eastern or hanging wall; 9 ft. ore; 4 ft. rock; 4 ft. ore; 2 ft. rock; 3 ft. ore; 3 ft. rock; 1 ft. ore; 6 ft. rock; 6 in. ore; 5 ft. rock; 1 ft. ore; 4 ft. 6 in. rock; 1 ft. ore; 1 ft. 6 in. rock; and 6 in. ore.

† Opened by the Chillagoe Option Co. 7 years ago.

running east-north-east and west-south-west, while the remainder, 5 ft. deep, runs east and west. Two holes have been sunk in the eastern arm, one (*d*) near the end being 7 ft. deep, the other, 26 ft. to the west, being 5 ft. deep.

The new whip shaft, which is 20 ft. north-north-west of the hole (*d*), was 85 ft. deep (water level?) when inspected, and cross-cuts had been opened for 40 ft. to the east, at the 40-ft. level, and for 40 ft. east-north-east and west-south-west at the 80-ft. level.

Eight men were working here on contract, but, unfortunately, the manager had business which prevented his being present at the time of my visit.

Output.

	15 tons at grass,	20%.
	8 „ „ „	40%.
October, 1906 ...	8* „ shipped.	

* Possibly from the Kalkadoon.

Ore-bodies.

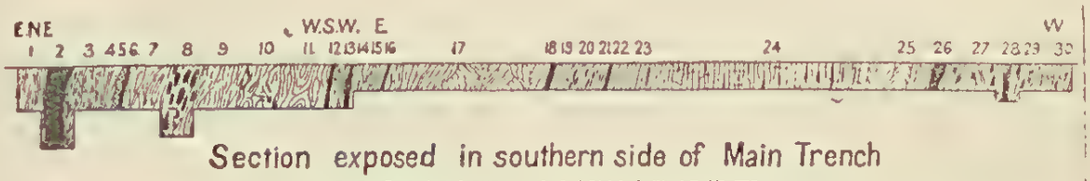
The main costean exposes ferruginous chloritic schists, dipping 80° to the east-south-east, in which can be seen 10 main bodies of gossany ore from 6 in. to 6 ft. thick, besides which small bunches and leaders of ore are found in the schists in five places over widths of from 5 ft. to 12 ft., while in one place slate is stained and carries bunches of ore over a width of 36 ft. (See Section.) The exposed ore at first glance might be thought to be rich in copper, owing to a thin surface film of malachite produced by leaching and evaporation. No ore that could be considered payable, under present conditions, was seen in the trench, though part of the 8 tons of tile-ore and malachite (40% copper) at grass is said to have come from the trench, as well as 15 tons of 15% carbonate ore, with limonite, tile-ore, and chalcopyrite.

A glance at the section shows that the ore-bodies fall into four groups (2, 3 and 6; 12, 14 and 16; 18, 20 and 22; and 26, 27, 28 and 29), each of which would have to be worked separately, although the workings might be connected to a central shaft. The ore-bodies are conformable, on the whole, with the bedding planes of the schist country, and there is no immediate probability of their uniting beneath the surface. They are very irregular in form, and are to be expected to cut out without warning, while others may appear, perhaps, at greater depth. Of those visible in the cut the eastern—numbered 2 on the figure—gives most promise of permanence.

That marked 6 has been worked in a 20-ft. shaft to the north, some ore from which was shipped.

That numbered 8 seems to be giving way to schist in the pothole, but the main shaft proved its permanence to 80 ft. depth. The body marked 14 opens out to 4 ft. width on the northern side of the trench, where it consists of siliceous limonite, with cuprite and a little

native copper, and also bunches of tile-ore and malachite-stained kaolinised schist—the whole probably averaging 10% copper. In the western part of the bed of slate marked 24 cupriferous bands,



Section exposed in southern side of Main Trench

MOUNT CUTHBERT

Scale 50 Ft. to an inch

10 0 10 20 30 40 50

REFERENCE.

1. 5 *ft. schist*
2. 3 *to* 5 *ft. gossany copper ore*
3. 5 *ft. schist with lenses of gossany ore*
4. 4 *ft. barren schist*
5. 1 *ft. formation*
6. 6 *to* 9 *in. ore*
7. 7 *ft. schists*
8. 6 *ft. gossan and formation*
9. 8 *ft. schist*
10. 7 *ft. kaolinised rk. remid with ore and sinter*
11. 9 *ft. schist*
12. 6 *in. ore* (5%)
13. 3 *ft. schist with ore*
14. 6 *to* 9 *in. ore*
15. 6 *ft. schist*
16. 6 *in. gossan*
17. 30 *ft. schist*
18. 1 *ft. bunch cupriferous gossan*
19. 3 *ft. slate*
20. 5 *ft. slate with malachite* (5% *copper*)
21. 2 *ft. slate*
22. 6 *in. ore*
23. 12 *ft. slate*
24. 36 *ft. green stained kaolinised slate with bunches ore*
25. 12 *ft. schist*
26. 2 *ft. to* 9 *in. cupriferous gossan*
27. 12 *ft. schist with gossan leaders*
28. 9 *to* 18 *in. cupriferous gossan*
29. 6 *ft. schist with gossan leaders and bunches*
30. 6 *ft. schist.*

18 in. wide, are separated by barren rock. In the band of slate marked 20 copper, as malachite, amounts to 5%. There are 15 tons of 20% ore at grass from this costean.

The presence of much copper-bearing limonite is evidence of the former existence of fairly dense chalcopyrite, during the oxidation of which much copper would be leached downwards. Prospecting by sinking on one of the ore-bodies and cross-cutting to test the others was therefore justifiable.

Some good ore was secured in sinking the main shaft, presumably from the band marked 16 in the section, the 40-ft. level crosscut being in 12 and 14. The crosscuts in the 80-ft. level were examined

under difficulties, owing to the manager's absence, to the fact that the contractors were at work in it, and that the walls are plastered with mud. At the shaft bottom the bluish schists are slightly copper stained (surface band 16); 15 ft. west of the shaft is a 6-in. copper-bearing vein (one of the 18, 20, 22 group), and then barren schists; but 6 ft. east of the shaft is a 5-ft. band (12, 14 group) of rich carbonate ore (30%? copper), beyond which, however, there are only leaders, with, however, some black oxide or secondary sulphide (No. 8 in section) towards the face. About 8 tons of 40% ore at grass is reported to have come partly from the main shaft and partly from the long costean.

An interesting exposure of copper-stained gossan is to be seen in the old shaft (*a*) to the south-east of the above. The gossan varies from 3 ft. to 7 ft. in thickness, and has irregularly replaced schist. It contains 10% quartz and 10% schist, the remainder being dense and cellular limonite. Very little copper is showing, but it may be depended on to come in towards water level. On the surface the gossan seems to pinch out within 10 ft. to the south and within 15 ft. to the north, but the body should be prospected, as considerable enlargement may take place in depth (as at Cobar, where the country is very similar to this).

In the trench (*b*) only kaolinised schist with thin quartz veins can be seen, but between the trench and the shaft there is a crop of gossan.

Mount Cuthbert North (M.L. 108).

Location, Etc.

This adjoins M.L. 107 on the north.

Its area is 20 ac.

There are no workings.

Ore-bodies.

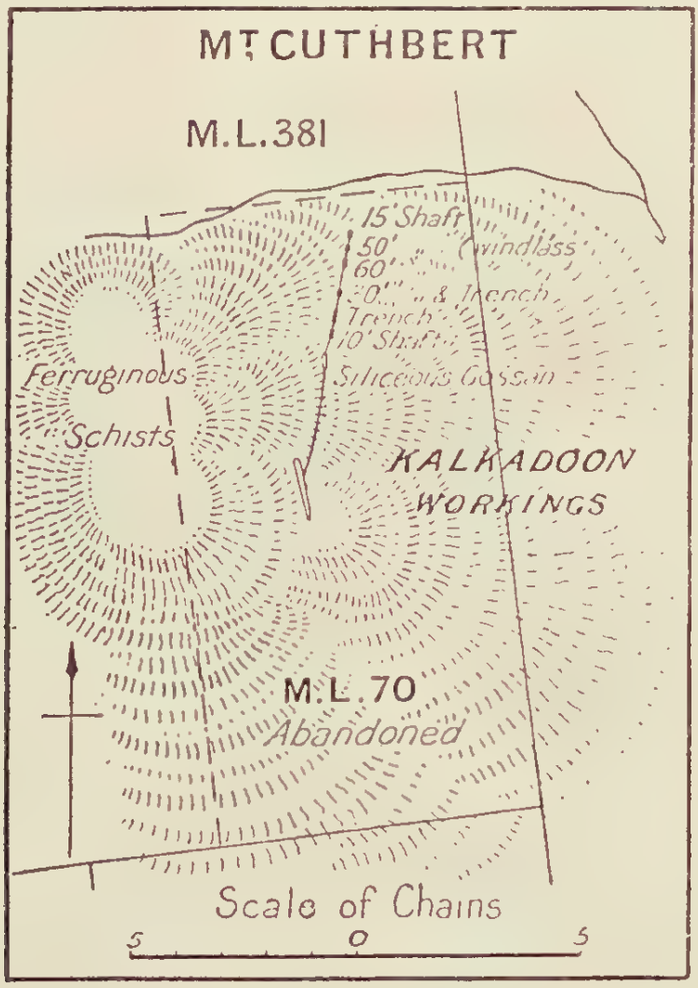
No ore-bodies were seen here, beyond a crop of quartz in the arch of the anticline between the Mount Cuthbert and Kalkadoon workings. The Mount Cuthbert belt should continue through the south-eastern corner of this lease.

Mount Cuthbert No. 1 North (M.L. 381).

Location, Etc.

This adjoins M.L. 108 on the north.

Its area is 40 ac., includes forfeited M.L's. 70 and 109—the old Kalkadoon and Kalkadoon No. 1 North.



DEVELOPMENT.*

The old Kalkadoon workings are at the northern end of the old lease. At 3 ch. from the north-eastern corner there is a shaft (*a*), 15 ft. deep. Then, 15 ft. to the south is the underlie windlass shaft (*b*), 50 ft. (?) deep and now inaccessible, from which a trench, 5 ft. deep, runs 12 ft. to the north. A further 50 ft. south of that is another inaccessible shaft (*c*), 60 ft. (?) deep, north and south of which ground seems to have been stoped out. Again, 40 ft. beyond is a 30-ft. shaft (*d*), with levels south for 20 ft., at 12 ft. from the surface, and north for 20 ft., at 15 ft. from the surface. At 15 ft. further south is a trench (*e*), 12 ft. long and 5 ft. deep; and 12 ft. to the

* The managers' reports published in the Press prior to 5th November, 1907, show that the No. 1 shaft at 50 ft. from the surface exposed 15 in. of massive glance, and at 61 ft. 12 in. to 18 in. of the same ore. No. 2 shaft at 85 ft. below the surface showed 18 in. of 25% ore, and at 100 ft. 6 in. of 20% ore. The southern drive from this shaft at the 75 ft. level proved 3 ft. of high-grade ore at 52 ft. from the shaft, 3 ft. of 15% to 20% ore and 2 ft. of 40% ore at 95 ft., 18 in. of 25% ore at 85 ft., and 5 ft. of 25% ore at 108 ft. from the shaft. In the western crosscut 43 ft. south of the shaft on the same level 10 ft. to 11 ft. of 10% ore was proved. The northern drive was in only 7 ft. on 4 ft. of gossan formation. The firsts at grass at the beginning of August amounted to 85 tons, and the seconds to over 100 tons.

south again is a 10-ft. pothole (*f*). No one was on the ground at the time of visit, and much difficulty was experienced in approaching the shafts, of which only one or two of the shallower ones could be descended.

Output.

1904	24	tons shipped (Kalkadoon).
1905	217	tons shipped (Mount Cuthbert).
1906	178$\frac{15}{20}$	tons shipped.
	200	tons bagged on the ground, believed to average 40% copper.*
	619$\frac{15}{20}$	

Ore-bodies.

The ore-bodies occur as a succession of over-lapping lenses in a formation striking north 5° east and dipping steeply to the west. The ore bagged is reported to have been mostly glance and cuprite.

In the northern shaft (*a*) there is only 2 ft. of schist formation at the surface, and that appears to be pinching at the bottom.

The underlie shaft (*b*) shows little because of the timbering. It dips 5 in 1 to the west. Only about 5 tons of seconds (gossan and stained country) carrying 5% copper are at grass.

The shaft (*c*) also underlies, and is flatter towards the bottom. There is probably 3% copper in the tip at this shaft. The 8 tons of ore, at grass ready for sorting, consists of a mixture of gossan and malachite, limonite, with disseminated cuprite and quartz (original and drusy in cavities), chalcopyrite, pyrite (mosaic in limonite), and glance, the last, which is to be separated, carrying 35% copper.

In the shaft (*d*) beautiful, soft, foliated schist can be seen. The ore raised from the bottom of the shaft is an intimate mixture of chalcocite, malachite, and tile-ore. Most of that at the brace is quartz-bearing limonite and cuprite (with crystalline malachite in cracks), cementing angular quartz. A little quartz also occurs in drusy form in cavities.

In the cut 10 ft. from the shaft (*d*) the lode (malachite bearing) has pinched to 9 in., and the average in the shaft itself is 6 in. In the southern level of the shaft there is a formation, 6 to 12 in. thick, in which siliceous and ferruginous ores occur, in over-lapping lenticular bunches, not more than 6 in. thick. The country rock is dark chloritic schist, much slickensided internally, and altered east of the lode to yellow clay. At the shaft bottom, south end, a 2-ft. bunch of chalcopyrite-glance ore is exposed, but, at the north end, the body has given place to iron and copper stains

* Reason given that stacked at shaft is that it was now too late to carry to Normanton, and that it was impossible to secure camels.

over a width of 18 in. of quartz-veined schist. The chlorite schist here is slickensided internally, west of the lode, for 2 ft. as above, but the eastern country is more gritty and less altered, though copper-stained for 12 in. from the lode. This shaft should be continued, as there is a possibility of a large ore-body being struck here. The ore at the brace is very siliceous, being really a quartz breccia, cemented by limonite, with secondary silica in cavities and with strong stains of manganese dioxide, as well as malachite and chrysocolla; there is also some green-stained kaolinised schist. Much 10% ore could be culled from the tip, and 40 tons is bagged at grass, the "seconds" (quartz-bearing limonite) amounting to 25 tons, probably carrying 10% copper.

Only a few inches of ore are showing at the northern end of the trench (*e*), but there is 12 in. at the southern end. The ore here includes small angular quartz fragments cemented by quartz-bearing limonite (some of it stained by chrysocolla) and with malachite in open spaces.

The shaft (*f*) is being sunk alongside 6 to 18 in. siliceous limonite, in malachite-stained kaolin.

The siliceous gossan, containing some copper, widens out south of the last hole, being 20 ft. across ½ ch. distant from it, where it unites with or runs for a chain alongside an 18-ft. blow of silicified limonite or yellow jasper. The boulders, over a further width of 20 ft. east of the blow, have probably fallen from the crop.

The large blow, which is distinctly banded and contains white quartz, crops for ½ ch. to the north-north-west of the junction.

Mount Cuthbert 1 South (M.L. 257).

Location, Etc.

This adjoins M.L. 113 on the south.

Its area is 20 ac.

The workings comprise a 35-ft. shaft (*a*), in about the centre of the lease, and now inaccessible; a trench (*b*), 1½ ch. to the north; and trenches and holes to the south. This work was done by tributors during 1905.

Output.

40 tons, yielding 20 to 35% copper.

Ore-bodies.

A siliceous limonite crop runs south from the northern trench to the main shaft, in which 3 ft. of gossan can be seen going down vertically. The ore now at grass, amounting to ½ ton, consists of siliceous gossan, with chalcopyrite altering into glance—copper 5%—but some 40 tons are said to have been shipped for yields of from 20% to 35% copper.

A 6-in. siliceous gossan leader on an east and west joint has been trenched for 2 ch. from the shaft, and lead to the discovery of a small bunch of ore.

The ore-body seems to have pitched to the south at the shaft, for it was not found in the southern trenches and holes.

Mount Cuthbert No. 2 South (M.L. 396).

Location, Etc.

Adjoining M.L. 257 on the south.

Its area is 20 ac.

The one shaft, 25 ft. deep, near the northern boundary, was sunk early in 1906.

Ore-body.

The shaft is sunk in kaolinised schist, with abundant sintery magnesite and scattered masses of ore, consisting of kaolinised schist with quartz, limonite, malachite, and chrysocolla, exhibiting small quantities of the original pyrite. The copper content of the 3 tons at grass probably does not exceed 5%.

COOLULLAH.

The Coolullah district includes those holdings to the west of the station of that name, on the Leichhardt River, lying north of the Leichhardt River groups. These mines are all included within the catchment areas of Copper Mine and St. Paul's Creeks, a region of old land forms, approaching the peneplain stage.

WARWICK CASTLE GROUP.

The group lies about 3 miles south-west of Von Bremen's camp, on the head waters of St. Paul's Creek, 69 miles north-west of Cloncurry.

The ore-bodies are overlapping lenses of quartzite on a north-north-west line, and traceable for 1½ mile from the Castle to St. Paul's Creek. Beyond the creek the crops trend northwards, and run 1½ mile to the west of Von Bremen's Camp. The quartzite is broken and the schists are crushed in a similar manner to those at Duck Creek.

The timber is as usual thin and stunted box and bloodwood.

The Warwick Castle No. 1 North (M.L. 645), No. 2 North (M.L. 646), No. 3 North (M.L. 643), and the Evelyn (M.L. 644) are here omitted as not yet worked.

Warwick Castle (M.L. 314).

Location, Etc.

The Warwick Castle is at the head of St. Paul's Creek, 6 miles north-north-west from Mount Cuthbert, and 12 miles south-west from the Dobbyn.

Its area is 20 ac.

There were no workings at the time of my visit.

Ore-body.

The main crop is formed of green-stained, quartz-veined, schistose quartzite, a chain in length, 12 ft. in width and rising 20 ft. above the general slope of the ridge. The quartzite can be traced for 10 ch. south-south-east of the main "castle" and for 5 ch. to the north-north-west, where it forms a second but smaller blow. It is granular in parts, but much of it has the appearance of crystalline quartz. It has in some places been shattered and crushed and is then ferruginous, and on the whole is similar to the Tharsis and Chinaman crops at Duck Creek. No payable ore is in sight, but one or two small bunches of cellular malachite-bearing tile-ore were seen. It is therefore unlikely that, if sunk upon, the ore will average over 5% copper even after the rejection of 50% quartz. The country is schistose slate, with quartz lenses plentifully developed near the quartzite.

Kenilworth (Extended M.C. ?).

LOCATION, ETC.

The Kenilworth is ½ mile north-east from M.L. 314, and about 10 ch. east of the Warwick Castle line.

This is four men's ground—taken up as a block on the Warwick Castle line, for which there is no present justification.

One pothole has been sunk.

ORE-BODY.

In the pothole there is 6 in. to 2 ft. of quartz and gossan with some chalcopyrite, altering to glance, and also malachite but very siliceous. This is probably a bunch less than a chain in length.

The country rock is slaty schist.

Louisa (M.L. 643).

LOCATION, ETC.

The Louisa is on the northern side of the head of St. Paul's Creek, 1½ mile from the Warwick Castle.

Its area is 10 ac.

Only surface scratching has yet been done, the ground having been just pegged out.

ORE-BODIES.

Small patches of gossany ore are scattered over the surface with earthy calcareous sinter and quartz, the country rock being ferruginous schist.

Evelyn (M.L. 644).

LOCATION, ETC.

The Evelyn is on the southern side of the head of St. Paul's Creek, 1¼ mile north of the Warwick Castle.

Its area is 20 ac.

No work has been done and the ground was not inspected by me.

VON BREMEN'S GROUP.

This group is in the vicinity of Von Bremen's and Hare's camps, at the head of St. Paul's Creek, about 70 miles north-west of Cloncurry.

Most of the mines are of no economic importance, but several of them offer interesting geological studies.

Mount Stanley No. 1 South (M.L. 606), Emerald (M.C. 357) and Emerald No. 2 South (M.C. 367), Mount Cherry No. 1 North (M.C. 363) are not worthy of separate mention.

Isabella (M.C. 360).

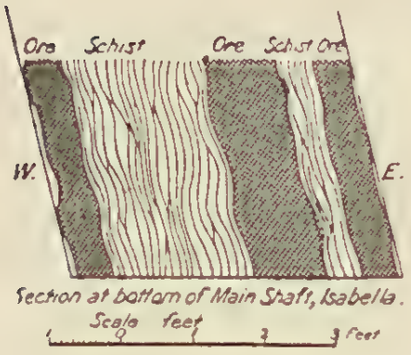
Location, Etc.

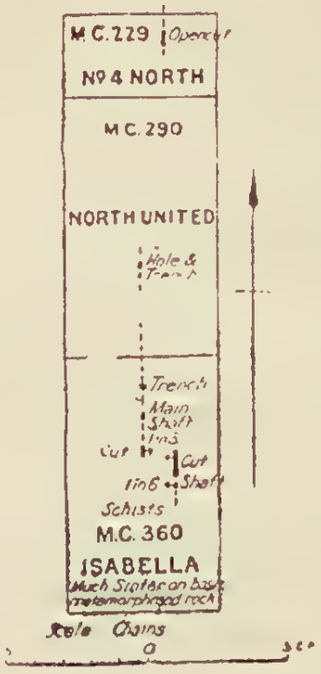
The Isabella, originally P.A. 257, is ¼ mile west of Von Bremen's camp on St. Paul's Creek, 71 miles north-west-by-north of Cloncurry.

Its area is 600 ft. × 350 ft.

Development.

The workings consist of, on the western lode, a trench (*a*), 1 ch. from the northern boundary, a main shaft (*b*), 45 ft. deep, a chain to





the south, and a cut (*c*), a chain further south; on the eastern lode a cut (*d*), 60 ft. long × 10 to 12 ft. deep, 1 ch. east of the cut (*c*), and a shaft (*e*), 25 ft. deep, 15 ft. to the south.

Output.

		14 tons shipped	25 to 26½%
		(15 ,, at grass)	
1906	...	9 ,, shipped.	

Ore-bodies.

The two ore-bodies, worked on this claim, were most likely formed in shear-zones by uprising solutions. They are parallel, one chain apart, and dip towards one another at steep angles.

In the northern trench, on the western lode, 2 ft. 3 in. gossany carbonate ore, with at least 10% copper, is exposed in the northern end, but there is only formation at the south end. The cap of the lode, averaging 9 in. in thickness, has, however, been traced southwards to the main shaft.

The main shaft shows no defined lode, but an internally slickensided schist formation, dipping 1 in 3 to the east, and similar to those

at Duck Creek, in which lie bodies of ore. The chloritic schist country is greatly crushed near the formation, and all faces are brightly slickensided. This is indicative of extensive shearing, and there is consequently considerable promise of the ore formation being permanent.

Most of the ore consists of chalcopyrite, altering throughout into limonite and glance, with some patches of ferruginous tile-ore and a little malachite. The 4 tons of ore at grass, secured from the last 15 ft. of sinking, may be expected to yield 40% copper. The cellular nature of some of the surface ore signifies that at water-level chalcopyrite is to be expected.

Sinking is, therefore, to be continued, and further prospecting should be carried out by cross-cutting.

In the southern cut (*c*) the schist, over a width of 3 ft., is slightly cupriferous and 2 cwt. of siliceous limonite, carrying 10% copper, has been paddocked.

The cut (*d*), on the eastern lode, shows that the ore is in the form of a succession of lenses, up to 12 in. thick, dipping 1 in 6 to the west. The ore shipped, 2½ tons, yielded 26% copper; and the 8½ tons (chalcopyrite and limonite with interlacing malachite) lying at grass, probably carries 30% copper.

The eastern shaft (*e*) is also sunk in a schist formation, the width of the shaft, with bunches of quartz and poor ore. The formation can be traced for a chain to the south.

The immediate country rock is a crushed chloritic schist, but to the south-east is basic igneous, highly metamorphosed but not schistose.

Isabella North United (M.C. 290).

Location, Etc.

This adjoins M.C. 360 on the north.

Its area is 600 ft. × 350 ft.

One 10 ft. hole and a trench are 3 ch. north of the southern boundary, and besides there is a cut on the southern boundary.

Output.

3 tons shipped, 25% copper.

Ore-body.

The hole is on the line of strike of the western lode in the Isabella, though the crop is not continuous. Shattered quartz, cemented by limonite carrying chalcopyrite and stained slightly by malachite, was found in the hole, but no payable ore is to be seen.

The cut on the southern boundary appears to be on a separate bunch lying to the west of the above. The ore raised from it amounted to 3 tons.

Isabella No. 4 North (M.C. 229).

Location, Etc.

This adjoins M.C. 290 on the north.

Its area is 200 ft. × 350 ft.

There is one opencut 25 ft. long and 15 ft. deep.

Output.

8 tons shipped, 32%
4 ,, at grass, 30% (?)

Ore-body.

The opencut is on the line of strike of the eastern body found in the Isabella. The crop, which extends due north for 2 ch. north of the cut, is made up chiefly of iron-stained quartz. The schist formation, which in the northern end of the cut is 9 in. to 2 ft. wide, carries bunches of quartz, chalcopyrite, and secondary oxides and sulphides, stained by malachite. Of the ore raised 3 tons of "firsts" from which all quartz has been separated and which is expected to carry 30% copper, remain at grass. The "seconds" at the brace amounting to 2 tons may carry 20% copper with considerable silica.

The ore-body is in a belt of ferruginous schist, in which other lenticular bodies are to be counted on.

Mount Hare (M.L. 642).

Location, Etc.

Mount Hare lies 1½ mile north-north-west of the Warwick Castle, and 2 miles west-north-west of Bremer's Camp on St. Paul's Creek.

Its area is 10 acres.

No work has yet been done, and the lease was not visited.

Ore-body.

It is reported that the crop consists of quartzite, stained green by carbonate of copper.

Hare's Excelsior (M.L. ?).

Location, Etc.

Hare's Excelsior lies 1 mile south-west of his camp, on Hare's Creek, one of the upper branches of St. Paul's Creek, about midway between the Dobbyn freeholds and Warwick Castle leases.

One shaft (*a*) 8 ft. deep, a pothole (*b*) 20 ft. to the west, and a trench (*c*) 30 ft. to the north of the latter are all the workings. No work was going on at time of visit, but it was proposed shortly to let a tribute to two men.

Ore-bodies.

The shaft was opened in gossany quartz at the surface, overlying 3 ft. of sintery formation, below which is an 18-in. vertical quartz reef, striking east and west. It carries, say, 10% of limonite with strong copper stains.

One or two lumps of ore seen exhibit original chalcopyrite, in process of oxidation into glance and limonite.

The country rock, a dark gritty slate striking north and south, is crushed for 6 in. from the lode, and contains quartz leaders.

The pothole (*b*) is on the same reef, here apparently contracting in depth and containing no visible pay ore, but worth prospecting.

The northern pothole (*c*) may possibly be on a faulted portion of the same lode. It reveals only 6 in. of quartz, but granular calcite occurs in the crop a few feet to the west.

A parallel crop of gossany quartz occurs 1 ch. east-south-east of the main shaft, and the schists, 2 ch. beyond, are stained with copper.

Generally speaking, there is very little to be seen here, but some work might be carried out in search of copper ore beneath the more gossany crops.

Mount Stanley (M.L. 584).

Location, Etc.

Mount Stanley is 2 miles west-north-west from Von Bremen's Camp, at the head of St. Paul's Creek.

Its area is 20 ac. The lease was not visited.

One shaft has been sunk 8 ft.

There are reported to be three lodes.*

Violet United (M.C. 317).

Location, Etc.

The Violet United is 1 mile south-east of Hare's camp on Hare's Creek, one of the upper branches of St. Paul's Creek.

This is ten men's ground—2,000 ft. × 350 ft.

One hole, 6 ft. deep, is near the north-western end.

Ore-bodies.

The ore-bodies occurring in the sedimentaries here may be presumed to, at least, owe their origin to the intrusion of the granite, even if the heavy metals did not directly emanate from the solidifying magma.

A few blocks, one foot in diameter, of cupriferous, cellular, gossan were found in the pothole, but nothing in the nature of a lode can be seen. The country rock is highly altered, siliceous slate, overlying and intruded by pink felspar granite, cropping west and south of the claim.

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*A sample of ore, consisting of iron- and copper- stained schist and quartz, taken from over a width of 9 ft. at the bottom of a 60 ft. shaft by Mr. W. A. Gordon, has been assayed for the following result (Government Analyst):—

Copper	=	2·2%
Gold	=	trace
Silver	=	1 dwt. per ton.

Several small masses of ore, of no continuation and known to the miners as "squibs," occur in the western part of the claim and there are some leaders near the centre, on which it is proposed to sink a shaft.

There is nothing here to warrant further work.

Mount Brown (M.L. 652).

Location, Etc.

Mount Brown is 1 mile south-east of Hare's camp, upper St. Paul's Creek.

Its area is 5 ac.

No work has yet been done.

Ore-bodies.

No body has been exposed, though the silicified country, proved cupriferous in the No. 1 North, continues through this lease. The silicified and crushed quartzites are here 30 ft. wide, but contain only stains of copper ore.

Mount Brown No. 1 North (M.L. 653).

Location, Etc.

This adjoins M.L. 652 on the north-north-west and the Violet on the south-east.

Its area is 5 ac.

There are no workings.

Ore-bodies.

The ore-bodies occur in a ferruginous and siliceous belt of altered sediments, adjacent to an intrusive mass of granite. Nothing payable or even worth prospecting has yet been proved here, but the occurrence is full of significance geologically.

A crop of silicified limonite, 30 ft. long and 10 ft. wide, occurs on the southern side of the knoll of silicificous slates in the centre of this lease. It carries stains of copper, which metal may have been introduced after the intrusion of the granite.

Mount Brown No. 1 South (M.L. 654).

Location, Etc.

This adjoins M.L. 652 on the south-south-east.

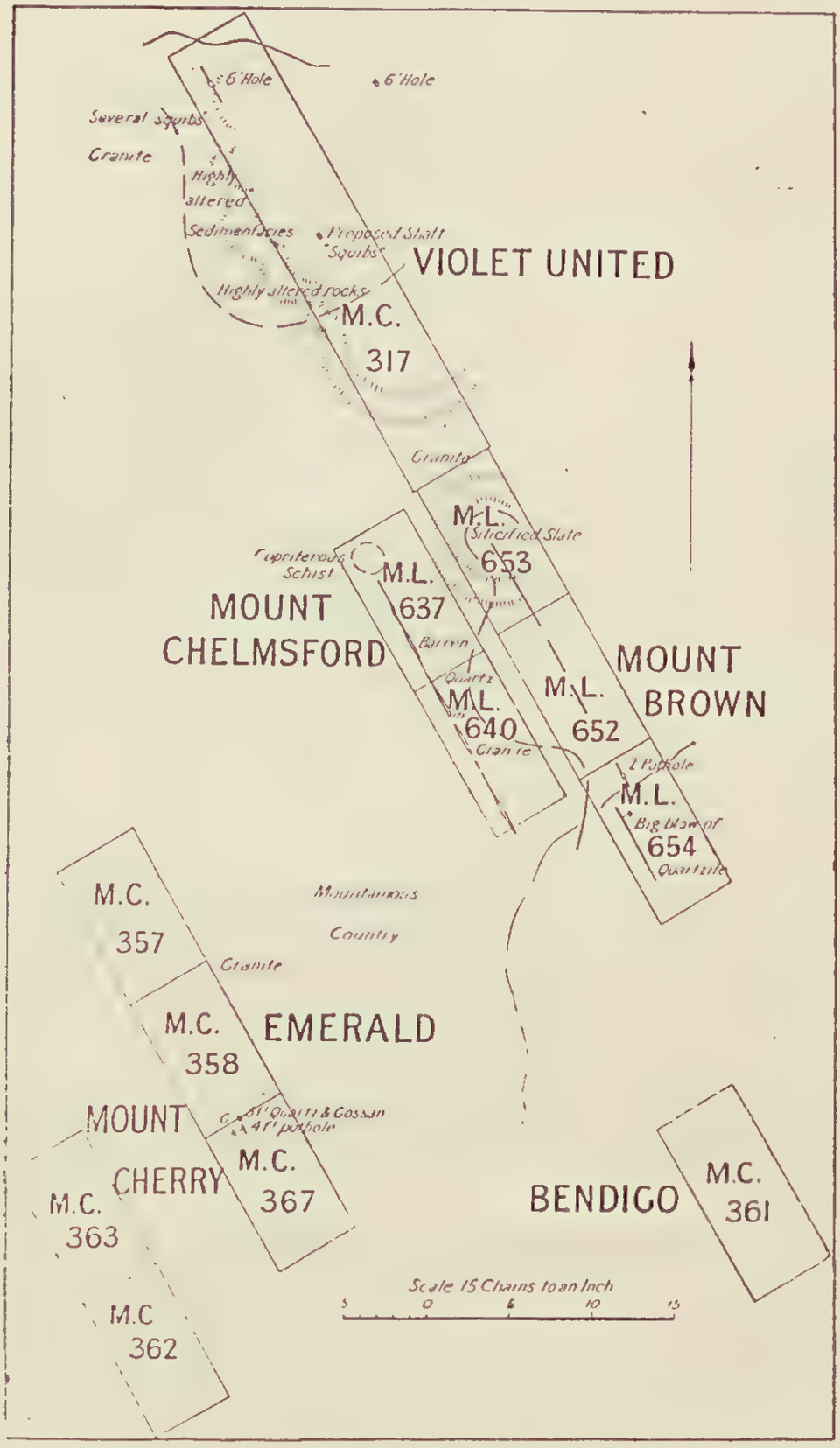
Its area is 5 ac.

One pothole, 2 ft. deep, is near the boundary of M.L. 652.

Ore-bodies.

Blocks of limonite, with original chalcopyrite altering into glance and containing some tile ore, have been taken from the pothole, some feet east of the line of strike of the Mount Brown siliceous crop, but no lode is exposed.

Across the creek to the south is a big blow of white quartzite, probably a continuation of the Mount Brown crop. This, it is reported, can be followed for several miles to the south.



Mount Stuart (M.C. 326).

Location, Etc.

Mount Stuart lies 1½ mile north-east of Mount Brown.

Its area is 600 ft. × 350 ft.

There is one hole, 12 ft. deep.

This claim is reported to be in similar country to that at the Violet, striking north-west and south-east.

Mount Chelmsford (M.L. 637).

Location, Etc.

Mount Chelmsford is to the west-south-west of, and separated by one chain from, M.L. 653.

Its area is 5 ac.

No work has been done.

Ore-bodies.

The ore-bodies comprise blows of quartzite, forming a line parallel to the Mount Brown crop. The quartzite has been shattered in one or two places, and has there been rendered cupriferous to a very slight extent. It was at first thought that these blows of quartzite indicated eruptive after effects of the cooling granitic magma, but the discovery of a few patches of schist in connection with them proves conclusively that they are older than the igneous rock, which has been able to almost completely absorb the comparatively basic schists, leaving the quartzites untouched. The small quantities of copper ores, in schist and quartzite, may, however, have been given off pneumatically from the granite.

The blows of pink quartzite are several feet thick, but contain copper ore in only one or two places, where shattered. At the northern end of the lease there is a small area of dark, schistose, somewhat siliceous, slaty rock, an inclusion of the sedimentaries in granite. A little copper occurs in the more schistose parts, the quartz, gossan, and crushed rock, on the north-western boundary of the lease, averaging between 3 ft. and 6 ft. This is the only part of the crop worth trenching even.

Mount Chelmsford No. 1 South (M.C. 294).

Location, Etc.

This adjoins M.L. 637 on the south-east.

Its area is 400 ft. × 350 ft.

There are no workings.

Ore-bodies.

Blows of pink quartzite occur here in granite, but very little copper ore can be seen, and that only where the quartzite is shattered.

Emerald No. 1 South (M.C. 358).

Location, Etc.

The Emerald claims have been taken up on a line parallel to the Mount Chelmsford and ¼ mile to the south-west.

The area of the No. 1 South is 600 ft. × 350 ft.

A pothole 4 ft. deep is on the south-eastern boundary.

Ore-bodies.

The ore-bodies in the Emerald claims occur both in schist and granite. They would appear to have been formed in the schist, and now occur partly in the granite, owing to the absorption of the original country rock by the molten intrusive magma, as at Mount Chelmsford. They are of little economic value, but of considerable geological interest.

In the northern portion of the No. 1 South quartz occurs in a schist belt a chain wide, presumably near the base of a trough, for there is granite on both sides.

At the southern end of the claim quartz and gossan, 3 ft. wide, dips 80° westwards in granite, into which pass numerous leaders and droppers from the lode. A few hundredweight of copper ore (limonite with chalcopyrite and secondary sulphides) have been paddocked. Nothing payable has yet been proved here, though traces of lode material have been found over the whole length of the three claims.

Mount Cherry (M.C. 362).

Location, Etc.

Mount Cherry is 6 ch. south-west of the Emerald.

Its area is 600 ft. × 350 ft.

One pothole has been sunk 3 ft. in the centre of the claim.

Ore-bodies.

The ore, of which only a few hundredweight have been paddocked, occurs in schistose rock, included in granite. Nothing payable has yet been found here.

The granite area, to the east of the Mount Cherry claims, contains many apparent "segregation" patches, which are really partly digested inclusions of the more basic sedimentaries taken up by the fluid magma.

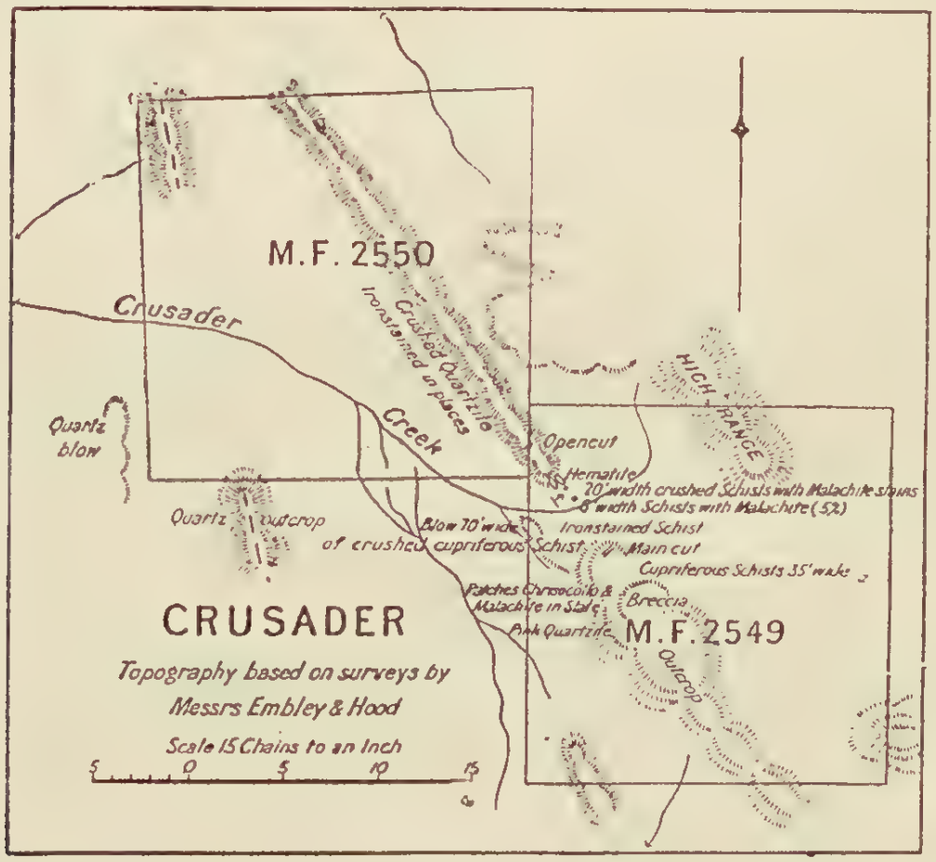
CRUSADER GROUP.

The Crusader freeholds are located on the Coolullah run, east of Coppermine Creek and 7 miles westerly from Coolullah head station. They have lately been resurveyed and remarked, but at the time of my visit the boundaries were not known and my inspection was therefore carried out under some uncertainty.

Several leases and claims have been taken up in the vicinity, and one, the Carpentaria (M.L. 566) formerly the Northerner, is within a few miles of Coolullah head station.

The Crusader ore-bodies occur in a belt of schist and crushed quartzite, striking north-north-west.

From any eminence a number of quartzite crops can be seen in this locality, most of the ridges being, in fact, due to them. Their divergence in strike is particularly noticeable and this irregularity is



probably due to contortion of the strata and does not indicate that the quartzites make the sites of fissures.

Literature.

(2) Mr. Jack reported thus:

A mile further, the *Crusader Copper Lode* (12 miles from Walsh's camp) stands up boldly above the surrounding country. Its matrix is quartz, which can be seen from a distance to be stained green with copper ore. The lode runs north 40 degrees west and is about 50 feet wide. On the surface and sides are large masses of copper ore and gossan. I broke out some fair samples of red oxide, malachite, and grey ore. The ore is more intimately mixed with silica than is usual in this district. A cutting has been driven into the N.E. side of the lode for a distance of about 15 feet. Besides copper ore, the cutting shows a large quantity of specular iron in a matrix of pale green talc. The association, in the same lode, of copper ore and ironstone, is suggestive, considering the number of enormous outcrops of ironstone which occur in the district.

(7) Mr. Rutherford says of the Crusader:

The freehold includes the northern end of a prominent quartzite range, which runs in a north and south direction over a large extent of country. The quartzite is iron-stained and associated with quartz, and shows patches stained green with copper salts. A cutting 25′ into the west side of the hill shows talc schist impregnated with iron and associated with copper carbonate. Some good bits of red oxide can be picked out of the mullock heap on the surface, but no body of ore could be seen in the trench and the stained ground could not be traced on the surface farther than a few feet. Following the quartzite to the north, across a small creek, about 100 yards, a second trench shows iron-stained slate, showing a few copper stains. Beyond this the quartzite continues hard and barren.

Crusader (M.F. 2549).

Location, Etc.

This freehold is located at the head of Crusader Creek, a branch of Soda Creek, which empties into Coppermine Creek, a tributary of the Leichhardt River.

The area of the block is 40 acres approximately. It was taken up under the old 1874 Mining Act as a mineral selection, and became freehold by the observance of the conditions.

Development.

The northern cut is on the crest of the ridge, just on the boundary of M.F. 2550. It is 18 ft. long, and in the north-eastern end there is a pothole 8 ft. deep.

The southern cut, on the north-eastern side of the ridge, 9 ch. south-east of the north-western corner, is 20 ft. long, and at the south-western end is 8 ft. deep.

Ore-bodies.

Barren quartzite forms the greater part of the crop in the south of M.F. 2549, but in the north-western part of the block the quartzite gives out to a great extent, and the schists there are impregnated and stained over considerable widths by malachite.

The northern cut exposes only silicified country veined with limonite, and the hillock to the north-north-west is built of crushed quartzite, iron-stained in places. A thin vein of carbonate ore has lately been brought to light in shallow potholes just to the south of the trench.

Two chains south-east of the northern cut the schistose country has been replaced, over a width of 4 ft. and a length of 30 ft., by granular haematite and magnetite, carrying malachite in the interstices between crystals. A little siliceous limonite also occurs here, but the crop is, on the whole, very disappointing from a copper standpoint. The crushed schists, just to the south of the haematite lens, are stained by malachite over a width of 20 ft., but the copper present on the whole is little more than a trace.

In the gully, half a chain beyond the last, fairly rich malachite ore occurs in schist, over a width of 6 ft.—the average contents being perhaps 5%. This should be opened up by trenching.

South of the gully the iron-stained schists continue for 2 chains, where they have suffered crushing to some extent, and form a blow about 70 ft. wide painted profusely with surface carbonate and in the more crushed parts containing some bunches of medium grade (10%) ore.

The main southern cut is one chain beyond, on the north-eastern side of the crop, here 35 ft. wide and consisting of ferruginous schists with bunches of copper ore—dipping 4 in 1 to the north-east. The

cut proves the schists to have been almost completely sericitised, with the development of plumose aggregates of sericite plates. Crystallised and granular hæmatite and magnetite (both strongly magnetic), introduced subsequently to the sericitisation of the rock, are very abundant and cellular limonite casts of original pyrite are also plentiful. The whole face of the cut is stained green, but only on the exterior, and there are a few bunches of fair grade (20%) earthy carbonate. My sample (38/B), taken from 16 ft. width on the south-eastern side of the cut, was examined at leisure, and found to consist of completely decomposed schist, stained a faint green by silicate and carbonate of copper. Some of the schist is cellular and iron-stained, owing to leaching out of pyrite. Only one small fragment of rich malachite and glance ore was included, and this showed a little native copper. The following is the result of analysis (Government Analyst):—

Gold	...	...	...	= nil
Silver	...	...	...	= nil
Copper	...	...	...	= 5·3%

The ore from the cut was stacked alongside it, but the heap has evidently been picked over, and only the poorer material, amounting to 3 tons, now remains. Crystalline radiating malachite occurs here in plumose sericite (?), and the ore contains 10% copper and 50% iron.

About 2 ch. south of this trench the crop is formed of a breccia of quartz, cemented by silicified limonite, the whole gradually passing first into cellular gossany quartz and then into pink quartzite, within 5 ch. of the cut. It would be worth while opening an adit on the north-eastern side of the gossany quartz crop and 40 ft. below the cap.

Some small cupriferous areas were noticed 2 ch. south-west of this portion of the main crop—the copper occurring as silicate and carbonate encrusting the sides of cracks in the siliceous slate country.

Crusader (M.F. 2550).

Location, Etc.

This adjoins M.F. 2549 on the north-western corner.

Its area is 40 ac.

Ore-bodies.

Little copper was seen on the northern freehold though the crushed quartzites traverse it as a bold ridge and continue for nearly a mile.

The cupriferous country exposed in the northern trench on M.F. 2549 must at least enter this. However, only a few chains to the north-west, crushed quartzites occupy the whole of the ridge, and preclude any likelihood of extensive ore-bodies being found on it.

Mount Leonard (M.L. 563).

Location, Etc.

Mount Leonard is ¼ mile west of M.F. 2549.

Its area is 20 ac.

No work has been done.

ORE-BODY.

There is here a north-and-south striking band of quartzite, 2 ft. to 10 ft. in width. It is generally iron-stained, and in parts has the structure of a crush zone.

Orphan (M.L. 667).

LOCATION, ETC.

The Orphan is one mile due east of Alchin's Camp, which is a mile east of the Dobbyn freehold.

Its area is 10 acres.

One pothole has been sunk at the end of the ridge in the southern part of the lease.

ORE-BODIES.

In present state of development it is impossible to generalise as to the nature of the ore-body, beyond stating that the crop is similar to the Chinaman, and may be part of a crush-zone. In about the centre of the lease there is a north-north-west striking quartzite crop of the Chinaman type, but rather more gossany than the original at Duck Creek. The width is 12 ft. and the total length of crop is 6½ chains, of which 1½ ch. at the northern end is very gossany and worth testing for low grade copper ores. The more barren part of the crop forms a low ridge, beyond which gossan and quartz rubble on the surface have induced prospecting, with the result that a ½ ton bunch of ore was located in a shallow hole. The ore, as bagged, consists of rather impure malachite with a little glance, the copper amounting to between 20 and 25%. It could however be picked much cleaner than this, with little trouble. The seconds at grass are very high in silica but should yield 5% copper.

The country rock is schist and the altered porphyry so characteristic of this district.

Three Jacks (M.C.).

LOCATION, ETC.

The Three Jacks claim is ¼ mile south of M.F. 2550.

It includes 3 men's ground, 350 ft. × 600 ft.

The workings comprise a shaft 10 ft. deep and a hole 2 ch. to the north-east.

OUTPUT.

1906 ... 3½ tons bagged, containing 25% copper.

ORE-BODY.

There is no defined lode, the ore occurring as bunches, up to 12 in. thick, in chloritic schist. The bunches, however, are connected by a vertical 2 in. formation, running east 35° north. The ore from here and adjacent patches has been bagged and amounts to 3½ tons—25% copper expected.

Flower (M.C. ?).

Location, Etc.

The Flower is 1 mile south-south-west of the Crusader.

The trench opened is 20 ft. long, 6 ft. wide, and up to 12 ft. deep—and is now partly filled in.

Ore-body.

The crop is composed of quartzite, dipping 1 in 10 vertical to the north 25° east. In the trench 18 in. of gossany quartz is visible. Of the ore raised 1 ton has been bagged, and 1 ton lies unpicked at the surface. The latter is chiefly granular limonite, with only stains of carbonates on the joints, and containing not much more than 2% copper. The bagged ore is much richer in malachite (as acicular crystals in tile-ore) the copper reaching 20%, but it is very siliceous.

Porphyry occurs in the vicinity.

Clinker (M.L. 565).

Location, Etc.

The Clinker lies ¼ mile south of M.F. 2550.

Its area is 20 ac.

There is one trench, 6 ft. long.

Ore-bodies.

This lease is traversed in a direction east 10° south by a crop of quartzite, showing bunches of fairly rich carbonates in places.

In the trench there is 2 ft. of quartz-bearing limonite on the foot-wall adjacent to 4 ft. barren white quartz. The gossan extends on the surface, for a distance of 1½ ch., and may be confidently expected to carry bunches of carbonates beneath the surface.

Other quartzite crops in this vicinity are not parallel to the above, and their divergence is to be explained by folding of the strata in which they occur.

Mount Sparklet (M.L. 564).

Location, Etc.

Mount Sparklet is ½ mile south-east of M.F. 2550.

Its area is 29 ac.

No work has been done here.

Ore-bodies.

The main quartzite crops lie on a line striking east 10° north. They are from ½ to 1 ch. in length and separated by blanks of from ¼ to 1 ch., in which no crop is to be seen. The separate crops are up

to 8 ft. in width, and some of them stand 10 ft. above the ground, the rather ferruginous over widths of 2 ft., and, where crushed or schistose, general effect being that of a ruined wall. The quartzite is in parts

FIG. 24.—QUARTZITE CROPS, MOUNT SPARKLET. [*L. C. B., photo.*

contains bunches of carbonate—the largest 10 ft. long and 2 ft. wide. It is thus similar to the Chinaman, though more ferruginous, and would appear to be due to concentration of original silica along crush-zones, formed during the folding of the strata.

The quartzite resembles that at the Chinaman in having at intervals a schistose structure, where it is rather more ferruginous. Bunches—the largest 10 ft. long and 2 ft. wide—of siliceous carbonate ore, say 10% copper, occur in the crushed or schistose portions.

A smaller parallel crop lies 5 ch. south of the above, and contains rich patches of ore a few pounds in weight.

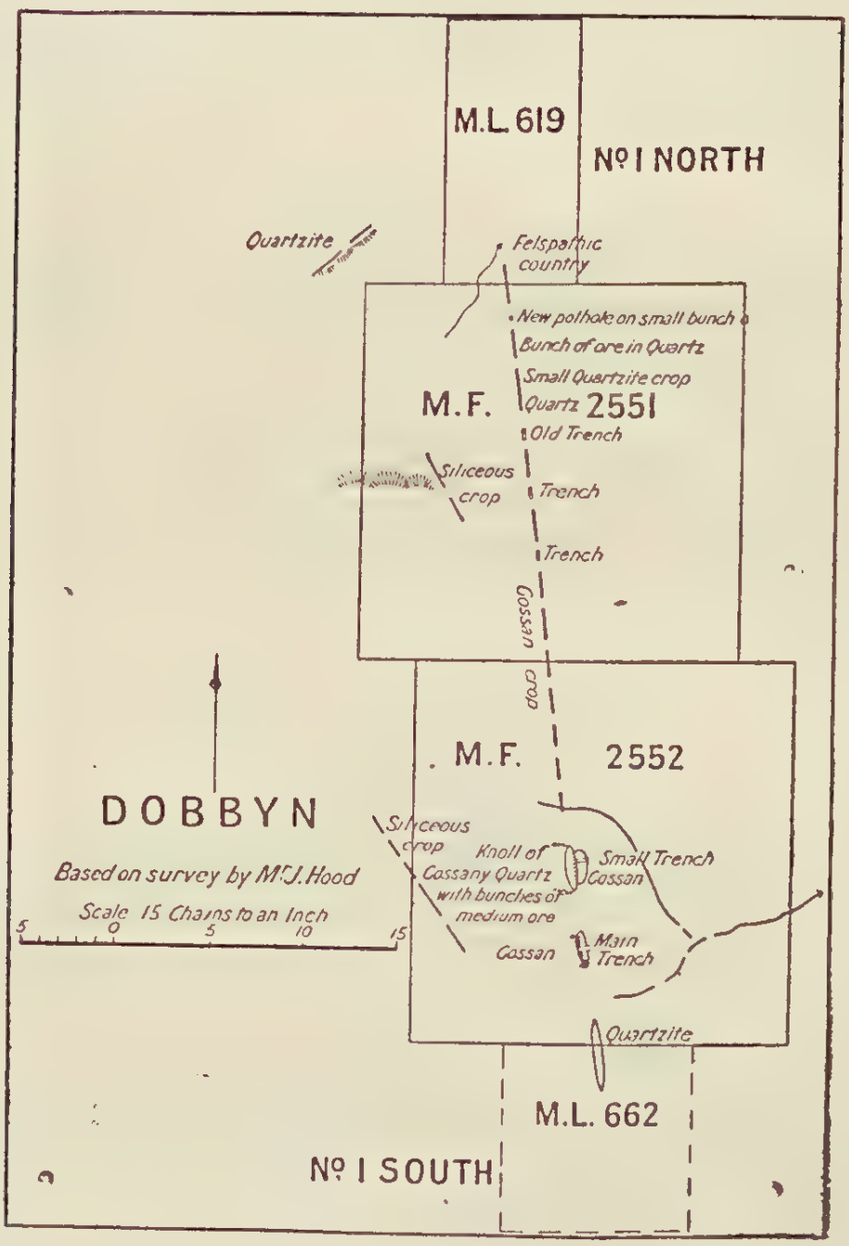
A big crop of quartzite striking north-west and south-east is to be seen in the north-eastern corner of the lease.

DOBBYN GROUP.

The Dobbyn freeholds lie 3½ miles west-north-west from the Mount Crusader freeholds, and the group includes, besides the two old freeholds, several leases and claims in their vicinity. Of these the Circe (M.C. ?) and Dobbyn 2 North (M.L. 646) were untested when visited and are not described below.

The country rock in the immediate vicinity of the ore-bodies is quartzite and schist, but a considerable development of schistose porphyry was noticed in the northern part of M.F. 2551.

Insufficient work has been done on the ore-bodies for it to be definitely decided as to what their nature is.



LITERATURE.

(2) Mr. Jack's visit was a hurried one, but he was able to note that "the lode is about 15 ft. wide and shows a promising gossan of green carbonate of copper mixed up with quartz."

(7) Mr. Rutherford's account of the Dobbyn is as follows:—

The surface shows small "blows" of iron-stained quartz and quartzite, some of which are copper-stained. An irregular hole 20′ across and 10′ deep shows siliceous schist stained with carbonate. Mr. Henry informs me that he sent away 10 tons of rich ore picked up as loose boulders from the surface. I could see no indications of ore on this property, and consider it of little value.

Dobbyn (M.F. 2551).

Location, Etc.

This is the northern of the two leases. It lies a mile west of Copper-mine Creek, at a point 10 miles above the Leichhardt River.

The block is 20 ch. square and contains 40 ac.

The work done consists of several old trenches, located at intervals of a few chains along the outcrop. Near the northern boundary miners, in ignorance of the ground being freehold, lately sunk a hole 8 ft. (*a*).

Ore-bodies.

The new hole (*a*) on the northern boundary has been sunk on iron-stained and gossany quartz. About 6 tons of very siliceous malachite-bearing limonite is still at grass. This may carry 15% copper.

Southwards there is no crop to speak of, the ore presumably occurring as bunches in a crush zone whose general trend is indicated by the fragments of gossan and quartz on the surface. Little can now be seen in the shallow trenches opened many years ago to prove the lode.

Dobbyn (M.F. 2552).

Location, Etc.

This adjoins M.F. 2552 on the south.

Its area is 40 acres.

The main cut, only 5 ch. from the southern boundary, is 20 ft. long and up to 8 ft. deep. A smaller trench lies 3 ch. to the north.

Ore-bodies.

The main trench was opened in a gossany crop, and exposes the following section:

On the west is schist country;
Adjoining it is 5 ft. gossan;
Then 5 ft. ferruginous country,* slightly stained with copper;
Then 5 ft. very gossany country;
Then 2 ft. 6 in. iron-stained country;
Then 2 ft. 6 in. ferruginous and copper-stained country;
And on the east is barren schist.

There are about 20 tons of siliceous gossany ore at grass containing perhaps a little over 5% copper chiefly as malachite.

The little knoll to the north of the main cut is formed of gossany quartz with bunches of fair quality ore.

* On the opposite (the southern) side of the cut this zone is 4 ft. wide and consists of limonite, quartz, etc., with scattered patches of glance-limonite ore.

Dobbyn No. 1 South (M.L. 662).

Mgr., Sweeney.

Location, Etc.

This adjoins M.F. 2552 on the south.

Its area is 10 acres.

A few potholes have been opened.

Ore-bodies.

The ore-bodies are bunches, up to 15 in. wide, in schist, dipping very steeply to the east. These are located on a line, which, if continued, would run about a chain west of the Dobbyn main line of workings and crops.

Much of the ore is high grade glance, some of it mixed with malachite, and generally free from quartz. From one pothole 1 ton of pure glance was taken, and from a cut 3 tons of glance-malachite ore, probably averaging 30% copper, was secured.

Some dense, high grade, glance ore has been found here—free from other minerals than limonite and malachite, the former as minute specks evenly distributed through the mass, the latter as very thin veinlets. In addition a few grains of chalcopyrite, yet unoxidised, can be seen. Another quality of ore is the cavernous amorphous malachite, in the less open portions of which some glance occurs, indicating that the malachite has been produced from its oxidation.

Dobbyn No. 1 North (M.L. 679).

Location, Etc.

This adjoins M.F. 2551 on the north.

Its area is 10 acres.

The one pothole, 5 ft. deep, is 2 ch. from the southern boundary.

Ore-body.

The pothole has been opened in the ferruginous quartz, representing the continuation of the Dobbyn crop, which is traceable for $\frac{1}{2}$ ch. to the north. It exposes 3 ft. width of quartz, with malachite pinching to 18 in. at the bottom, owing to the eastern wall dipping westwards, while the western wall is nearly vertical. The ore is very siliceous, but also contains much iron, and rich bunches of ore will probably be found if sinking and driving are carried out.

The immediate country rock is schist, but schistose porphyry forms considerable crops in the vicinity.

Bauhinia (M.C. 347).

Location, Etc.

The Bauhinia lies about $\frac{1}{2}$ mile north of the No. 1 Dobbyn.

Two men's ground, 350 ft. × 400 ft., is here included.

One hole, 3 ft. deep, has been opened.

ORE-BODY.

The crop is quartz, striking nearly north-east. From the hole, which was full of water at time of visit, 7 bags (5 cwt.) of ore have been taken. This consists of limonite with disseminations and veins of malachite, a fair amount of granular quartz, some glance, and traces of the original chalcopyrite. It may be expected to yield 25% copper.

The only rock crops in the vicinity are of porphyry.

Widow (M.C.).

LOCATION, ETC.

The Widow is on the western bank of Soda Creek, 2 miles east of the Dobbyn freeholds.

It is one man's ground—350 ft. × 200 ft.

There is one hole, 5 ft. deep.

ORE-BODY.

This appears to be a bunch of ore, not more than 10 ft. in length (east and west) and 18 in. wide, for though iron-stained quartz is to be seen on the surface, both east and west of the hole, the fragments have been shed from separate bodies.

The copper ore of which about 20 bags (¾ ton) have been separated consists of crystalline cuprite, surrounded by malachite-bearing kaolin.

The country rock, felspar porphyry, is not sharply defined from the ore-body, and is kaolinised to the north-east of the hole.

Dobbyn Lily (M.C.).

LOCATION, ETC.

The Dobbyn Lily is ¼ mile north-east of the north-eastern corner peg of M.F. 2551.

It includes 2 men's ground, which has not been applied for.

One 6 ft. hole has been sunk.

ORE-BODIES.

Lumps of glance-malachite ore are found in lime-veined schist.

Elsie (M.C.).

Mgr., Madden.

LOCATION, ETC.

The Elsie is about 2 miles west of the Crusader freeholds.

It includes 3 men's ground—350 ft. × 600 ft., not applied for.

The two potholes, 4 ft. and 3 ft. deep, lie 2½ ch. apart.

ORE-BODIES.

In the northern hole bunches of ore occur over a width of 3 ft., but, as it had lately been flooded, the exposure was not very distinct. About 5 tons of ore have been stacked. This consists of dense limonite, with disseminated radiating malachite and granules of quartz, and probably carries 10% copper, with 20% silica. This body is well worth sinking on.

For ½ ch. to the south 30° east of this hole the gossan has been silicified, but beyond that to the southern hole it carries little silica. The lode in the southern hole descends vertically and is only 12 in. wide. At the surface it is cellular, but beneath is more dense, and carries one-third malachite and chrysocolla, with say 20% silica. This also is worth sinking on, though the crop can be followed for only 6 ft. further southwards.

Nil Desperandum (M.C. 343).

Mgr., Wilmot.

LOCATION, ETC.

The Nil Desperandum is 1½ mile west of Coppermine Creek and 1 mile north of the Dobbyn freehold.

Its area is 400 ft. × 350 ft.—two men's ground, previously held as P.A. 289.

Four potholes have been sunk along and adjacent to the line.

OUTPUT.

2 tons shipped, 23½% copper (Alchin).

ORE-BODY.

A north-and-south crop of gossany quartz, with bunches of carbonate and oxide of copper, occurs in schists, dipping steeply to the east. The total length of crop is 3 chains, and holes have been sunk only where copper showed on the surface, leaving the most promising—the northern part—of the crop untouched.

Wilmot's (M.C.).

LOCATION, ETC.

Wilmot's is ¼ mile south of the Glenferrie.

One shallow trench has been opened.

ORE-BODY.

The ore is quartz, with limonite on joints, and carries chalcopyrite partly oxidised to limonite and glance. Of the copper ore (30% copper) about 1 cwt. has been stacked.

Glenferrie (P.A. 300)

Mgr., Wilmot.

Location, Etc.

The Glenferrie is near Old Man Creek, 3 miles south of the Boundary.

Its area is 10 acres.

Two potholes have been opened, 1½ ch. apart.

Ore-body.

The work done does not allow of the size of the ore-body being determined for certain, but it is probably between 2 and 3 ft. wide. The northern portion of the crop consists of quartz, but at the workings it is chiefly calcite.

At the northern pothole there are a few hundredweights of dense earthy malachite and limonite, and fibrous radiating malachite ore (mammillary and stalactitic in cavities), containing some quartz, but capable of being hand-picked up to 40%. Further work should be done here.

At the southern pothole the ore consists chiefly of ferro-calcite with chalcopyrite and interstitial limonite and glance. It would be difficult to concentrate this ore by hand above 10 or 15% copper.

The country rock just to the east of the lode, which strikes north-north-west, is the porphyry, but diorite occurs on the road a few chains to the west.

Flaneur (M.L. 655).

Mgr., Alchin.

Location, Etc.

The Flaneur lies 3 miles south-south-west of the Boundary claim and a mile west of the Dobbyn freehold.

The lease, which is 10 acres in area, includes the old Fop and Cad claims.

Development.

The main shaft in the north-western portion of the lease is 30 ft. deep. It is proposed to open a drive to the south-east, the ore being much richer there than towards the north-west. Some 40 ft. to the north-west is a pothole 10 ft. deep and 4 ch. to the south-east is a cutting (the Cad) 3 ft. deep. A chain to the north-east of the main shaft there is a shallow trench on No. 2 lode, which has also been exposed to a depth of 4 ft., 2½ chains to the north-west.

Very little can be seen in any of the cuttings, and most of the ore at grass has come from the main shaft.

Output.

8½ tons bagged at grass, high grade.

Ore-bodies.

Two distinct lines of crop, a chain apart, have been found on this property. There is no special sign of permanence in these lodes, except the fact that they crop for several chains on the surface.

In the shaft, on the south-western crop, the footwall country is a basic crystalline rock; the wall itself is ill-defined, but a smooth face has been found about 2 ft. in from the formation, which dips 5 in 1 to the north-east, varies from 9 in. to 2 ft. in thickness, and consists of crushed country replaced, in some parts, by quartz and, in others, by copper ores. The ore thus far has been richer in the south-eastern end, the dense limonite, beneath the surface quartz, having minutely interlacing veins of glance, with some specks of malachite, while tile-ore and crystalline malachite are appearing towards the bottom. Considerable boulders of a dense glance—presumably replaced limonite—are also found in the formation, stained on cracks by malachite.

A trench 10 ft. north-west of the main shaft has been opened on the quartz crop, and is reported to have touched ore, but has now fallen in.

The Cad cutting, opened in gossany quartz, proved fairly rich carbonate ore beneath.

The trench on the No. 2 lode tapped some medium ore, warranting further work on it.

On the south-western boundary there is a long crop of somewhat gossany quartzite, which might be tested in the more contracted parts by shallow holes.

BULL CREEK GROUP.

The group is named on the map after the Boundary. Bull Creek is a small affluent of Coppermine Creek, with a general course from west to east.

Porphyry outcrops are here as at the Dobbyn, very noticeable, especially towards the head of the creek.

The Boundary South (M.L. ——) is left out, as the holders failed to locate ore.

Boundary (M.L. 582).

Mgr., Lloyd.

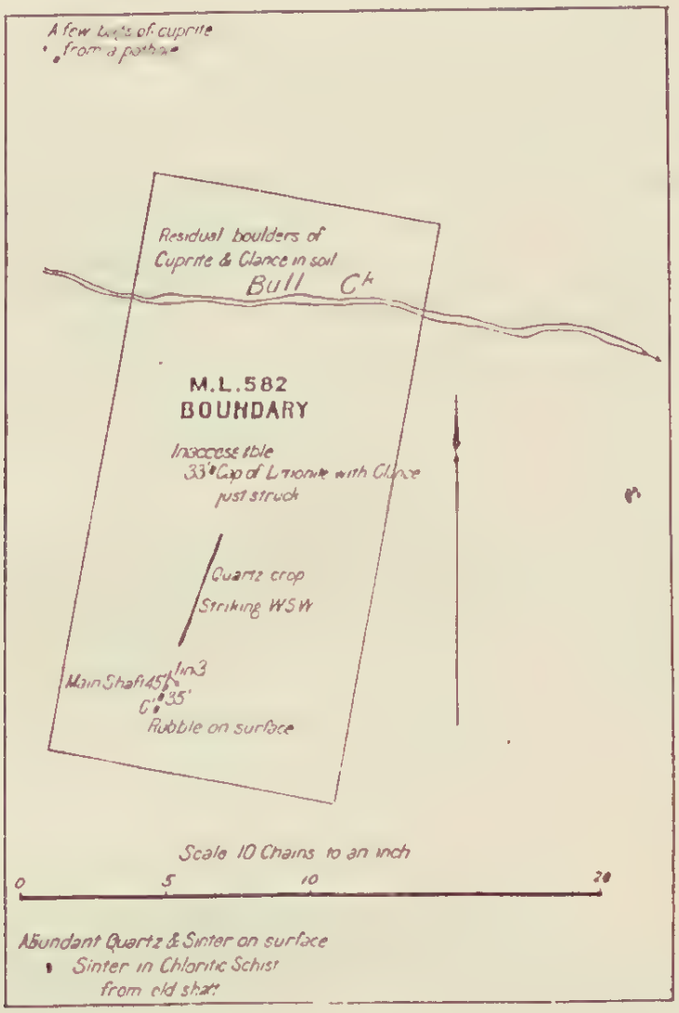
Location, Etc.

The Boundary is located on the western boundary of the Coolullah run, in the north-western corner of Coolullah Block No. 2 West, about 4 miles north of the Dobbyn freehold. Bull Creek, a tributary of the Coppermine, runs through the northern part of the lease.

The area of the lease is 20 acres.

Development.

The main workings are at the southern end of the lease. The working shaft is 45 ft. deep, and an air shaft (inaccessible), 12 ft. to the south, is 35 ft. deep. At the bottom of the main shaft, drives have been opened, north for 12 ft. and south for 10 ft. No stoping has been done, but the shaft is 10 ft. long and 5 ft. wide.



A pothole has been sunk 6 ft., at 20 ft. south of the air shaft.

Near the centre of the lease, a shaft has been sunk 33 ft. (inaccessible), and temporarily abandoned because of a sudden influx of water.

North of Bull Creek much "coyoting"—burrowing and shallow trenching in the soil—has been carried out, but in order to locate the lode or lodes it will be necessary to put a deep trench right across the copper-bearing ground.

Output.

65 tons* yielded from 20½% to 49½%

* The value per ton at the mine being £15, when copper stood at £92 per ton.

Ore-bodies.

The country rock is white, speckled, chloritic schist (possibly a crushed diorite), with segregated lenses of quartz, having a north-north-easterly trend. The cupriferous portion of the main ore-body makes little show on the surface, but the more siliceous parts are well marked.

In sinking the southern shafts boulders of rich ore were found to water level at 40 ft. On the 45-ft. level of the main shaft the copper ore is seen to occur in bunches in the lode, which itself is very irregular in width, the bulges being from 1 to 2 ft. thick. The copper ore at water level (40 ft.) is chiefly glance and with some chalcopyrite but small amounts of cuprite are found together with native copper. The gangue minerals are quartz (gossany in the northern level) and limonite (much of it siliceous). Some stains of malachite were noted and also a little chrysocolla.

The central shaft is a chain to the west of the line of strike of the main lode. Stains of carbonate and bunches of ore, with much calcareous sinter, were found in sinking and the cap of a lode, very jaspery in appearance but containing some glance, was struck at the bottom of the shaft. This, to judge by the ore at the brace, is worthy of further trial. The country rock here has suffered considerable alteration, being both softened and replaced to a large extent by earthy oxide of iron.

In the northern part of the lease scattered boulders of limonite, with glance and bunches of cuprite, coated with a thin film of chrysocolla, occur in the soil, with an abundance of sinter leached from the decomposed basic country rock. Solid rock has not yet been reached, and the lode has therefore not, so far, been located.

There would appear to be several overlapping lodes on this lease, though the work done does not allow of any very definite conclusions being drawn. The main lode strikes north-north-east, but the three groups of workings lie on a north and south line, and there is no sign of cross faulting.

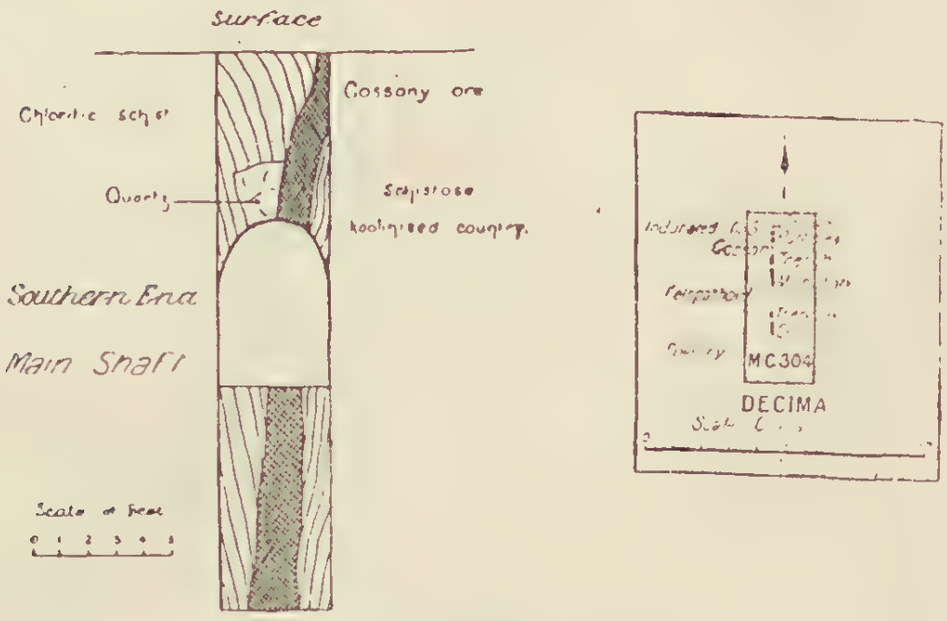
Decima (M.C. 304).

Location, Etc.

The Decima lies on the reddish soil plain ½ mile south (slightly west) of the Boundary.

The vegetation consists almost entirely of stunted mountain (or desert) gum and spinifex.

The area, according to the Warden's register, is 400 ft. by 350 ft., but only half that area appears to have been pegged out. Unfortunately the claim, being under exemption, was deserted at the time of my inspection.



Development.

The workings comprise two potholes, (*a*) 2 ft. 6 in. and (*b*) 5 ft. deep, at 14 and 16 yds. from the northern boundary; a trench (*c*), 18 ft. long and up to 7 ft. deep, 15 yds. south of the last; an opencut (*d*), 23 ft. long, 2 ft. deep at the northern end, 5 ft. in the middle, and 10 ft. at the south; the main shaft (*e*) adjacent to the last, 20 ft. (?) deep, has a drive, 10 ft. in length, from the southern end, at 12 ft. below the surface; a trench (*f*), 16 yds. south of the shaft, 4 ft. deep; and a trench (*g*), 30 yds. south of the shaft, 20 ft. long and 6 ft. deep.

The main shaft should now be continued to water-level in search of rich secondary ores, which are to be expected beneath all the gossan crops.

Output.

1906	...	5 tons shipped 9 ,, bagged.

Ore-bodies.

The Decima ore-body appears to be on a fracture plane of some extent and though this cannot be designated a true fissure, there is hope of some permanence. The only rock cropping at the surface besides the gossan is a porphyry, occurring as weather-rounded boulders, chiefly to the west of the lode, but the country rock adjacent to the lode is schist.

The Decima outcrop, which can be followed through the greater part of the claim, lies on the eastern side of, and partly within, an irregular belt of porphyry, which passes 10 ch. to the west of the

Boundary workings. Its strike is due north and south, and it is nearly vertical. Between the main and northern workings it is especially noticeable, consisting of up to 2 ft. 6 in. of gossan.

In the northern pothole (*a*) the footwall, which is well defined, dips 5 in 1 to the east. The lode is pinching slightly (from 2 ft. to 18 in.), but should be sunk on. About ½ ton of siliceous carbonate "seconds," of 10% tenour lies at grass.

The exposure in the trench (*b*) is similar, except that much decomposed country is included in the ore at the north end and that stains of carbonate are visible on the footwall. Only 1 ton of siliceous carbonate "seconds" is at grass.

The footwall country, in the main opencut (*c*) and in the shaft (*d*), is seen to be schistose but kaolinised, the hanging-wall country in the shaft being chloritic schist, broken by spurs of quartz. The lode, consisting of cupriferous gossany ore, increases from 18 in. near the surface to 2 ft. in width towards the shaft bottom. It occurs on a well-marked break, the footwall country further being kaolinised to a greater extent than the hanging-wall, which, however, is rich in quartz veins. The exposures in the shaft and drive are indicative of permanence, and the cupriferous gossan of rich secondary ores, beneath whence sinking should be continued. Of the ore raised 280 bags (12 tons) lie stacked at the shaft, the seconds—siliceous carbonate bearing gossan, containing 15% copper—amounting to 3 tons.

The trench (*f*) shows only 12 in. of gossan, the footwall country here being indurated adjacent to the lode.

Water in the trench (*g*) prevents a complete examination, but 6 in. to 18 in. of gossan is visible in the ends—the crop extending for 20 ft. south of the trench. Only "seconds"—cellular siliceous gossan, with thin veins of chrysocolla and malachite (3% copper)—amounting to ½ ton, remain at grass.

Iguana (M.C. 268).

Mgr., Huddlestone.

Location, Etc.

The Iguana lies ½ mile north of the Boundary.

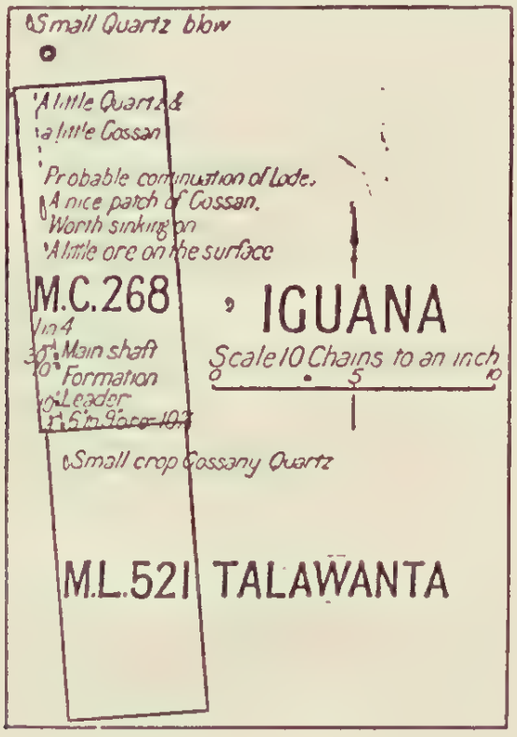
It is a mineral claim 800 ft. by 350 ft.—four men's ground.

Output.

Only 2 or 3 tons of ore have been shipped—yielding 37% copper, but 2 tons of ore lie bagged at the shaft ready for shipment. There are a few hundredweights of rich glance "firsts"—probably 40% ore—at the brace, and a few hundredweights of quartz-bearing limonite with radiating malachite, expected to carry 10 to 15% copper.

Development.

On the southern boundary is a pothole (*a*) 4 ft. deep; a chain to the north is a hole (*b*), 10 ft. deep; a chain and a half further north is another (*c*) of the same depth. The main shaft (*d*), 20 ft. north of the last, is 30 ft. deep. Two men were at work here at the time of my visit.



Ore-bodies.

The Iguana lode strikes north 5° west (dipping 4 in 1 westwards) and, if it continued southwards, would intersect Lloyd's main workings. The line of crop comprises small quartz blows, patches of gossan, and ore scattered over the surface of the ground; and it can be traced without difficulty some chains beyond the boundaries of the claim.

In the main shaft the ore to a depth of 10 ft. consisted of quartz-bearing limonite containing malachite, but the ore now being raised from 30 ft. depth contains glance as well as malachite. The copper ore occurs in ill-defined bunches, up to 2 ft. in width, in a formation of internally slickensided and kaolinised schist—4 ft. across in places. The hanging-wall, which cannot now be seen in the shaft, is reported to be very smooth, and this, with the slickensides in the schist, indicates the formation to be a shear zone, in which other bunches of ore are to be expected in depth.

In the pothole (*c*) the formation can be distinguished but no ore.

In the southernmost pothole (*a*) there is 6 in. to 9 in. of siliceous ore, dipping steeply west in schist country. The ore is stained by malachite and may be expected to assay 10% copper.

The pothole (*b*) is on a leader, at least 10 ft. west of the main lode. No copper ore has been found in it.

Cathedral (M.L. 573).

LOCATION, ETC.

The Cathedral lies 1 mile west of the Boundary.

Its area is 20 ac. and the ground was formerly held as the Peacock claim.

It was idle at the time of my visits to the locality, no work having been done on it since its conversion from a claim.

OUTPUT.

1½ tons (red oxide) yielded 43% and 35%

,,

ST. PAUL'S GROUP.

St. Paul's Creek enters the Leichhardt River about half way between Coolullah and Kamileroi homesteads, draining a large area of country to the south-west.

Little work has been done on any of the crops, and no body of any importance has yet been discovered.

The Pelican was not visited.

Rosette (M.L. 638).

Mgr., Steel.

LOCATION, ETC.

The Rosette lies ¾ mile east of St. Paul's Creek and 4 miles north-west of the Boundary.

This is a lease of 10 acres.

The main shaft, 20 ft. deep, is in the western corner of the lease; two potholes, 6 ft. and 5 ft. deep and 8 ft. apart, lie a chain to the south-east and a small trench has been opened in the northern corner.

OUTPUT.

6	tons shipped, Nov. '06,	expected 30% (Mgr.)	
½	,, firsts	yielded 40⅜% (M.O'S)	
	,, seconds	,, 33⅝%	,,
Total 7	,, shipped		

ORE-BODIES.

The little work done here has not shown anything of promise—the ore occurring in bunches in small formations of no extent so far proved.

The main shaft has been sunk in copper-stained, kaolinised, chloritic schist, on a 12 in. formation, striking north 15° east, in which bunches of ore are found. The ore raised—malachite and glance—amounting to 6 tons has been shipped and is expected to yield 30%.

The western pothole exposed a formation 9 in. to 12 in. wide, while the eastern pothole shows a separate formation, 6 in wide, from which 1½ ton of malachite and tile-ore, assaying 42%, has been bagged.

At the northern trench there is a lenticular bunch of iron-stained quartz, in schist country, probably less than 20 ft. long but up to 10 ft. wide. The quartz is glassy and shattered, the cracks being lined with hydrated iron oxide, in which specks of gold have been detected by the manager.

The copper ores (carbonate and oxide) occur in a formation in juxtaposition to this. About $1\frac{1}{4}$ ton of rich ore has been taken from the trench.

Lady Emma (M.C. 356).

LOCATION, ETC.

The Lady Emma is located 2 miles up St. Paul's Creek from Hill's Camp and the Chance.

There is one shaft 12 ft. deep.

OUTPUT.

5 tons shipped.

ORE-BODY.

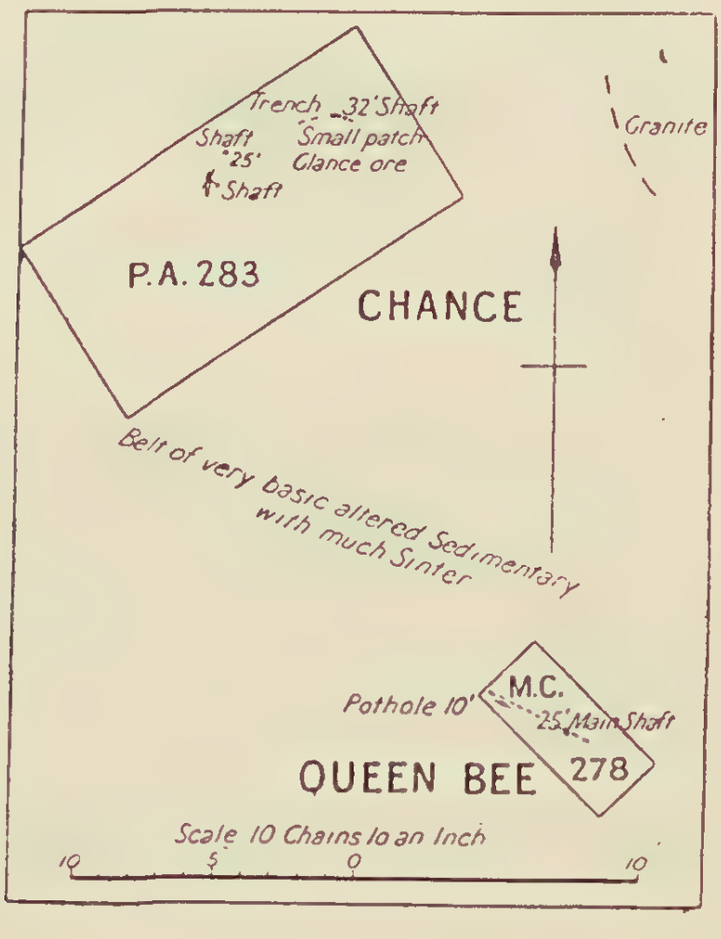
It is reported that the ore-body, which is of fair grade, is 2 ft. wide.

Chance (P.A. 283).

LOCATION, ETC.

The Chance lies $4\frac{3}{4}$ miles west of the Boundary and 1 mile beyond St. Paul's Creek.

Its extent is 10 ac.



Development.

The main workings are in the northern corner of the area. The main shaft is 32 ft. deep and is now being sunk a further 10 ft. in search of bunches of ore. Separated from the main shaft by only 2 ft. is a pothole, 10 ft. deep on the east; and 10 ft. to the west there is a trench 10 ft. long, with a hole 10 ft. deep at the western end. A hole has been sunk 15 ft. 4 ch. to the west-south-west from the last, and a chain beyond to the south-west of there is a shaft 15 ft. deep.

Output.

2	tons shipped by previous holders, 43% and 35% copper (Seaton)					
6	,,	bagged at grass, expect 37% copper				
6	,,	,,	,,	,,	30%	,,
3	,,	,,	,,	,,	40%	

Ore-bodies.

The amount of work done on the Chance does not warrant certain expression as to whether there is one or more lodes, though the former has been assumed to be the case. The country in the area is a slaty rock, which, in the northern workings, is seen to be schistose. The occurrence of intrusive granite, only 10 ch. distant from the workings, is suggestive as to origin, but there are no pneumatolytic minerals accompanying the ores. Still the heat evolved by the granite must have aided solutions in dissolving the metals prior to precipitation in concentrated form.

The rich ore has evidently been originally chalcopyrite, but partial oxidation has taken place, through the whole mass, the iron producing limonite and the copper glance. These minerals now appear as a liver-coloured base, in which are scattered specks of yellow chalcopyrite.

At the main shaft the strike is west-north-west. It was opened on a 2 ft. formation, which widened to 2 ft. 6 in. at 20 ft. below the surface, but has pinched to 12 in. at the bottom. The formation, which is ill-defined, with very irregular walls, in parts consists entirely of crushed country but in others carries bunches of rich ore, some gossan, and quartz. Their scattered occurrence, however, renders exploitation somewhat expensive—only 10 tons of (37% to 42%) ore having been raised, of which 6 tons bagged are still on the ground. The ore at the brace, amounting to 5 cwt., consists of enriched chalcopyrite and glance and probably contains 60% copper.

The country rock at the main workings is schist the apparent strike of which is west-north-west, but granite occurs within 10 ch. to the east.

Only a 6 in. formation can be seen in the trench west of the shaft, but glance ore lies on the surface a chain further west.

The 25 ft. shaft has been sunk, in bleached country, on a very ferruginous formation, 2 ft. wide, consisting in great part of limonite,

and containing tile-ore and chalcopyrite in limonite, but remarkably free from quartz. The ore at grass amounts to 6 tons, expected to yield 30% copper. Sinking should be continued here as the most promising place on the area.

The south-western shaft is at the contact of quartz, which crops on the surface for over a chain, and gossan, latter about 2 ft. thick and dipping steeply south-east. The country is slaty and the walls are not defined. Three tons of ore have been bagged from this shaft.

Queen Bee (M.C. 278).

Location, Etc.

The Queen Bee lies 500 yds. south-south-east of the Chance, on a flat covered with mountain gum and spinifex.

This is an ordinary claim of two men's ground—400 ft. × 350 ft.

The main shaft which is 8 ft. long and 6 ft. wide is 25 ft. deep; and, 2½ ch. to the west-north-west, there is a hole 10 ft. deep.

Output.

1½ ton shipped, carrying 35 to 43% ore (Seaton)
3 tons just shipped } expected to yield 20% copper
1 ton at grass }

Ore-bodies.

Beyond that the claim is in metamorphosed sediments in the vicinity of granite and that the ores occur in an irregular formation little can be said.

The ore-bodies in the main shaft occur in an irregular formation, perhaps 10 ft. wide, making no show on the surface. Attached to the hanging-wall, which strikes north-west and dip almost vertically to the south-west, is much sintery kaolin, and "floors" (flat sheets) of sinter also occur in various parts of the formation. The ore consists of limonite and glance.

An indistinct jointing, or bedding, crosses the shaft almost at right angles to the formation, but the exposure is very indefinite.

The pothole to the west-north-west is also on a formation worth prospecting.

A ton of ore lying at grass consists of limonite stained by carbonate and containing a few specks of the original chalcopyrite, with copper amounting to perhaps 5%.

In addition to this 17 bags of 45% glance ore are said to have been taken from here.

Copper is distributed throughout the mullock tip, which amounts to at least 100 tons and probably contains 3% copper.

DONALDSON.

The mines north-west of the Donaldson telegraph station were the latest discoveries seen by me. They are situated on the eastern side of the Dromedary Range, which extends northwards for nearly 30 miles from Coolullah homestead.

The Black Nobby (M.L. 684) was not visited, and no particulars regarding it are available, except that it lies 8 or 10 miles north of the Eclipse Group.

ECLIPSE GROUP.

The group is located 9 miles west of the Cloncurry-Normanton telegraph line and is 68 miles north-by-west from Cloncurry.

The surrounding country is low-lying, being part of a peneplain, approaching the base level of the neighbouring rolling downs. The surface features much resemble those of the Duck Creek and other wide-bottomed valleys in the Cloncurry district.

The leases had not been surveyed when they were visited at the end of 1906, and the men on the ground were unable to give me the boundaries of the leases, consequently the particulars given below are somewhat indefinitely stated.

Metamorphism has been intense in this district, but it has taken place without the excessive crushing and the production of cupriferous quartz-bearing zones so typical of the greater part of the mineral field. The country rocks noticed include quartzite, hornblende-schist, felsite, pegmatite, etc., and quartz lenses are not as frequent as in most other parts of the field.

Stunted bloodwood is the most abundant timber, being generally accompanied by spinifex.

Eclipse (M.L. 571.)

Mgr., Hillcoat.

Location, Etc.

The Eclipse is situated 12 miles north-west of Donaldson telegraph station which is 58½ miles north-by-west of Cloncurry.

Its area is 10 ac.

Development.

The workings, which are all in a state of collapse, begin 4 ch. north-west of the south-eastern corner of the lease, with 2 potholes, the eastern 5 ft. and the western 6 ft. deep, 1 ch. north of which is the main shaft, 15 ft. deep. A third pothole 5 ft. deep lies 20 ft. south-west of the main shaft. The northern shaft, about 15 ft. deep, is 3 ch. north-north-west of the main shaft. At 20 ft. south-east of this shaft there is a trench 8 ft. long, 6 ft. wide, and 4 ft. deep.

Output.

1906 ... 17 tons shipped
20 ,, at grass, 30%

Ore-bodies.

The country rocks here are highly metamorphosed, hornblende-schist being much in evidence in the southern part of the lease. Towards the north there is also a considerable development of granophyric and some pegmatitic structure, in the more siliceous and felspathic rocks. Almost all the openings on the lease appear to be on different ore-bodies.

The main shaft is on an irregular north and south striking bunch of high grade liver-coloured ore (an intimate mixture of chalcopyrite, tile-ore, limonite, and chalcocite with disseminations and veinlets of malachite). The body is 3 to 4 ft. wide at the surface but at 8 ft. below it is from 6 in. to 3 ft. wide. About 10 tons of 30% ore lie at grass. The country adjacent to the ore is a decomposed rock, probably slate.

At the 5 ft. hole to the south, which is on the same line, 5 tons of 30% ore have been paddocked, while at the adjacent hole there is the same quantity of 35% ore.

The hole to the south-west of the main shaft has produced 1 ton of 40% liver-coloured ore.

Gossan can be seen on the surface at the northern shaft but there is little sign of it continuing any distance, though rich ore is showing, over a width of 2 ft., along the whole length of the adjacent trench, and another 6 in. crop of fairly rich ore can be seen 2 ch. to the south. The country here is a highly altered felspathic rock. In all 10 tons have been shipped from the northern workings and there is 1 ton of 30% oxidised ore at grass.

Lady Catherine (M.L. 621).

Mgr., Hillcoat.

Location, Etc.

The Lady Catherine adjoins the Eclipse on the south.

Its area is 10 ac.

Ore-bodies.

No crops were seen in this lease but the soil is highly ferruginous and similar bodies of ore to those found in the Eclipse are to be looked for.

Lady Molly (M.L. 620).

Mgr., Hillcoat.

Location, Etc.

The Lady Molly adjoins the Eclipse on the north.

Its area is 10 ac.

Only two or three shallow potholes have been opened on this lease about ¼ mile north of those on the Eclipse.

Ore-bodies.

The country rock here has the appearance of highly altered sedimentaries, in which segregation and crystallisation has taken place with the production of a pegmatitic structure in parts. Small ore-bodies, 18 in. wide, have been exposed on a north and south line in the eastern holes, but only a couple of hundredweights of payable ore have been saved.

A belt of quartzites, lying 1 ch. to the west, shows slight indications of copper contents, and a small hole, in sintery red soil at the northern end of the belt, has yielded a few pounds weight of copper ore.

Work is therefore not to be encouraged here.

Cosmo (M.L. 668).

Mgr., Hillcoat.

Location, Etc.

The Cosmo adjoins the Lady Molly on the west.

Its area is 10 ac.

Wanderer (M.L. 622).

Mgr., Hillcoat.

Location, Etc.

The Wanderer lies ¼ mile west of the Cosmo.

Its area is 15 ac.

One pothole 5 ft. deep has been opened.

Output.

3 tons of ore raised, carrying 30% copper.

Ore-body.

The ore obtained appears to have been in the form of a small bunch. Cellular gossan was found on the surface and underneath it fine-grained glance-malachite-tile-ore, rich in iron but free from quartz.

Hornblende schist and an altered porphyroidal rock occur in the vicinity. The sedimentaries are highly altered and pegmatitic segregations are very common, more especially on a line running north-east and south-west within a few feet of the pothole. Actinolite is here a very abundant secondary mineral.

Nothing to encourage further work was seen here.

GUNPOWDER CREEK.

Gunpowder Creek rises near Kennedy's Gap on the West Leichhardt telegraph line, and flows northwards to within a few miles of Mount Oxide, when it bends and runs east-north-east to the Leichhardt River. The country within its catchment is mostly mountainous, and uninviting for most purposes.

CALTON HILLS GROUP.

Only one lease had been taken up here at the end of 1906, to my knowledge.

Overlander (M.L. 661).

LOCATION, ETC.

The Overlander is 17 miles down Gunpowder Creek from Calton Hills homestead, which is 81 miles west-north-west of Clonourry.

Its area is 10 ac. The lease was not inspected.

Rich specimens of radiating malachite in quartz were shown me by one of the owners, who reported the mineral to be plentiful.

BIG BEN GROUP.

This group is to the north and on the opposite side of Gunpowder Creek to the Overlander.

Besides that described below, there are the Big Ben No. 1 (M.L. 574) and Big Ben No. 2 (M.L. 575).

Big Ben (M.L. 380).

LOCATION, ETC.

Big Ben lies east of Gunpowder Creek, 21 miles north-north-west of Calton Hills, and 98 miles north-west of Cloncurry.

Its area is 5 ac.

OUTPUT.

About 10 tons of ore have been shipped.

EASTERN CREEK GROUP.

Eastern Creek is one of the eastern tributaries of Gunpowder Creek, entering it about 15 miles north of Calton Hills Station.

The Osprey (M.L. 726) which is located at the head of the creek is the only lease in the group.

MOUNT OXIDE.

Mount Oxide is located between Torpedo Creek (a branch of Gunpowder Creek) and Myally Creek (a tributary of the Leichhardt River). It is in the extreme north-west of the district considered in this report.

MOUNT OXIDE GROUP.

Mgr., Douglas Henry.

LOCATION, ETC.

Mount Oxide lies in about the centre of the triangle formed by joining Camooweal, Burketown, and Cloncurry. The nearest human habitation at the present time is Alsace, 25 miles down Gunpowder Creek; its distance, in an air line from Burketown, being 123 miles and from Cloncurry 109 miles.

The leases are strung along a precipitous ridge, near the head of a branch of Torpedo Creek, 6 miles above the junction of the latter with Gunpowder Creek, a stream of some importance, entering the Leichhardt River between Kamileroi and Lorraine head stations.

A track for vehicles has lately been made, *viâ* Myally Creek, from the mine to Lorraine, on the Cloncurry-Burketown road (60 miles), but horsemen generally prefer the short cut (50 miles) from Kamilaroi, *viâ* Alsace. A camel pad westwards has lately been opened down the Thornton River to the Camooweal-Burketown road (55 miles).

LITERATURE.

(4) The following are Mr. Cameron's statements:

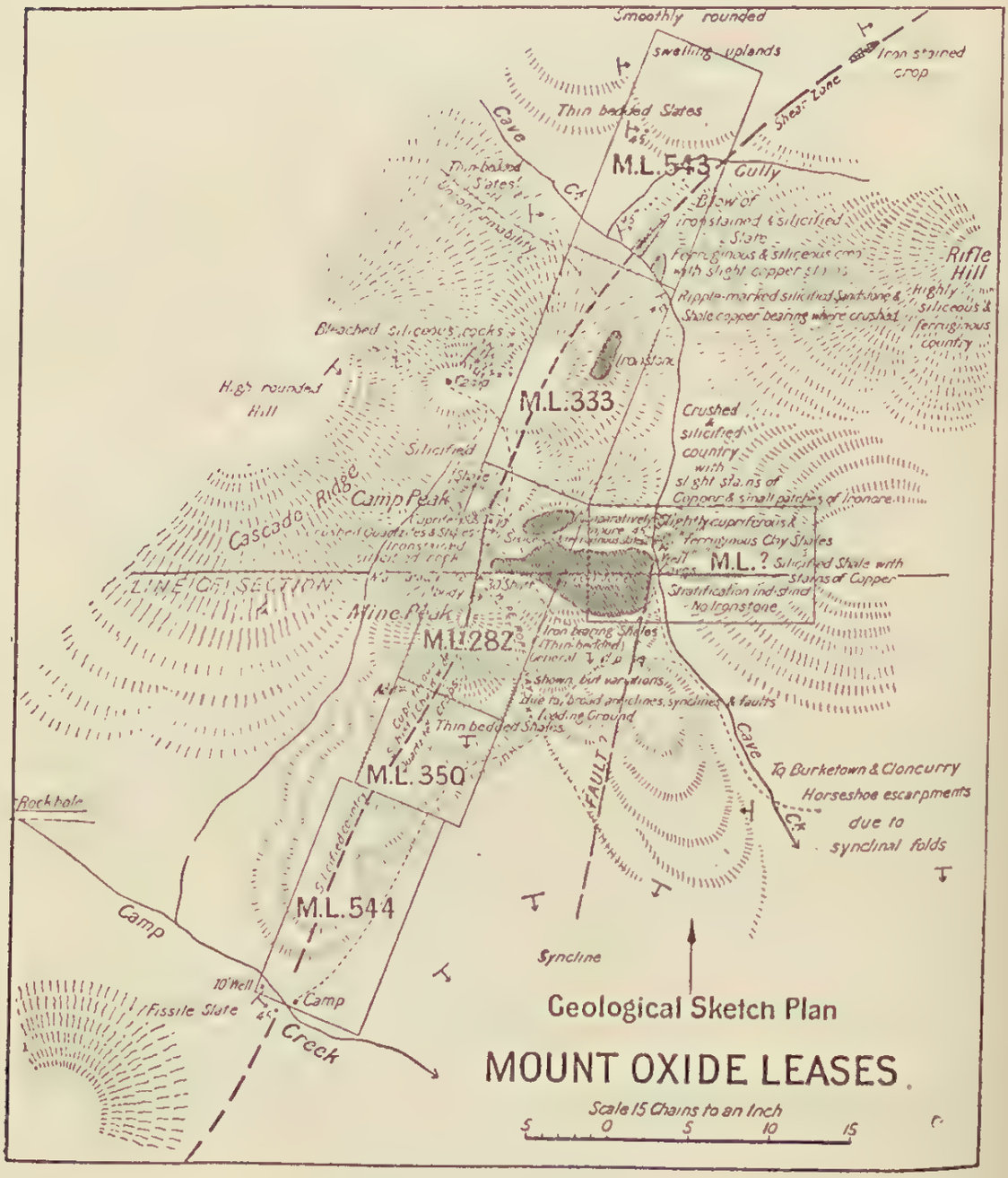
The crest of the spur is formed by a band of bedded quartzites which outcrop along it, striking about south 30 degrees west, and dipping steeply to the east. Underlying this quartzite belt is a bed of clay shales. The lode consists apparently of the upper beds of these shales impregnated with fine quartz veins and copper ores. It shows as a very prominent outcrop along the crest of the hill for a distance of some 10 chains in length, and is in places 40 feet in breadth. An average sample across the southern end of the outcrop gave a return of 1·3 per cent. of copper, a trace of gold, and 9 dwt. 2 gr. of silver per ton. Another average sample taken from across the lode about 8 chains further north gave a return of 28 per cent. of copper, a trace of gold, and 1 oz. 10 dwt. 1 gr. of silver per ton. The lode here is about 10 feet in width, and is more ferruginous and quartzy in character, and continues so for about 2 chains further north. Beyond this it can be traced for a further distance of about 5 chains by detached outcrops of quartz and carbonate ore. This lode will be an expensive one to work from its inaccessibility, but otherwise it shows very good prospects. The initial prospecting could very easily be done by open cuts across the lode from the western side before any more elaborate work was taken in hand.

(7) Mr. Rutherford concludes:

The outcrop is made up of a prominent ridge of bedded quartzite running in a north and south direction for a distance of 300 yds. Underlying the quartzite is in places a band of shale which is generally more stained with green carbonate than the quartzite itself. The "stained" formation varies in thickness from a few feet up to 40 ft. in places. At a place 130 yds. from the extreme northern end the formation is 15 ft. wide. Three feet of this carries some good copper ore for a distance of 17 yds. This is the only place where any body of ore can be seen. It is my opinion that a bulk assay right across the formation in any other part would not yield more than a trace of copper.

History.

Mr. Henry was taken by blacks to Mount Oxide about 25 years ago. He secured the ground in 1900, and placed it, on option, in the hands of the Burketown Railway Company, who abandoned it in 1903. Early in 1905, Mr. Henry again pegged out the ground and placed his son in charge. On my arrival at the mine, Mr. Douglas Henry had four men with him.



Area.

The leases are five in number: The Mount Oxide (M.L. 282), No. 1 North (M.L. 333), No. 2 North (M.L. 543), No. 1 South (M.L. 350), No. 2 South (M.L. 544), and No. 1 East (M.L. ?), and the area is 10 acres in all cases except that of No. 1 South, which is only 5 acres. They have not been surveyed, and the manager has no plan, that published herewith having been made by me on the ground with Mr. Douglas Henry's assistance in locating datum pegs, &c.

Development.

The main workings are on M.L. 282: A 30-ft. shaft, and an open-cut, 8 ft. deep, 8 ft. wide and 20 ft. long, just to the south-west of the shaft. Three chains to the north is an abandoned shaft, 10 ft. deep.

In the north-western corner of M.L. 350 an adit, now 7 ft. long, has been commenced nearly 100 ft. below the ridge top.

In the south-western corner of M.L. 544, a well has been sunk, to a depth of 70 ft. in purple and yellowish-green fissile slate. Very little water was obtained.

On M.L. (?) is a 14-ft. well, giving a fair supply of water for one man.

The workings being in the initial stage, the ore-raising appliance consisted simply of a windlass and a No. 4 wire rope-way to the loading ground, 8½ ch. distant.

Output.

1905	...	40 tons ore,	containing	30%	copper		
1906	...	40 ,,	,,	,,	30%	,,	
		30 ,,	,,	,,	40%	,,	(estimated)
Total		110 ,,	,,	,,	33%	,,	,,

Ore Developed.

The main ore-body has not yet been sufficiently opened up for a reliable estimate of ore available to be made. At the time of my visit the main bunch of ore could be traced, on the surface, a distance of 2¼ chains, but had been properly exposed only in the opencut and shaft. It may, however, reasonably be assumed that ore will be found between the surface and lines joining the ends of the crop and the shaft bottom. The average width remaining 3 ft., over 700 tons, which ought to run between 20 and 30%, should be available.

No work has been done on the cupriferous schists, and therefore no opinion can be expressed as to their value.

Treatment and Transport.

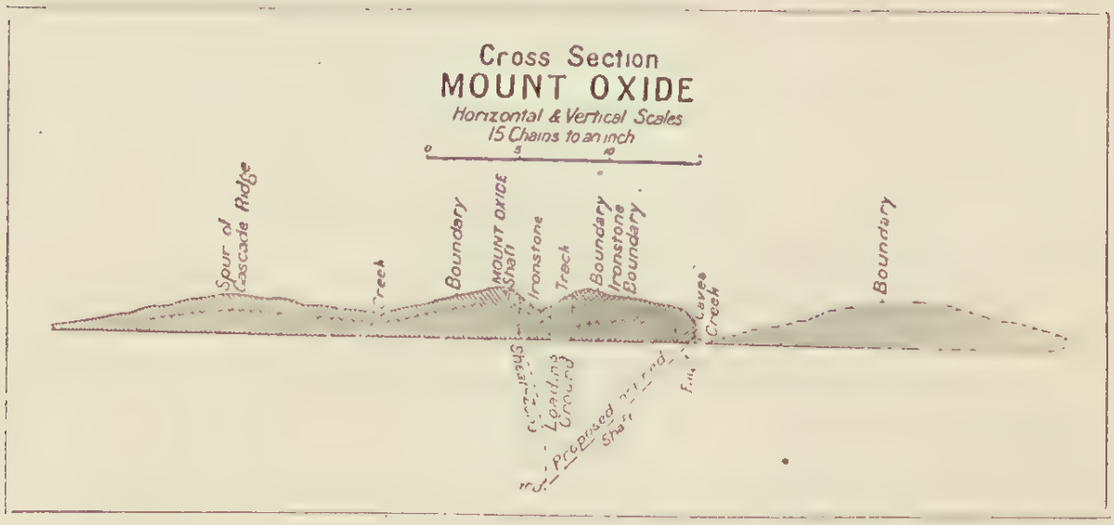
The only treatment the ore receives at the mine is a rough sorting by hand, prior to bagging. When bagged it is carried 55 miles by camel to the Thornton Hotel, on the Burketown road, where it is transferred to horse teams, on their way to Burketown, and thence shipped to Southern smelters.

Geology and Mineralogy.

The Mount Oxide ore-bodies lie along a shear-zone, which is traceable for several miles, at least to Torpedo Creek on the south, but has not yet been proved cupriferous beyond Henry's leases.

The country rocks to the west are fissile slates, dipping at an angle of 45° to the south-east; to the north-east, the country is highly silicified and shows little trace of stratification (any observed having

a southerly dip); but, to the south-east, occur apparently overlying, thin-bedded, calcareous slates, forming a broad geo-syncline, with north and south major axis.



Along the shear-zone, the slates have been rendered schistose, generally highly siliceous, and in places cupriferous. One bunch of high-grade oxychloride has been found and is being exploited in the main shaft (*see* Mount Oxide—M.L. 282).

Between the shear-zone of Mount Oxide on the west and a fault and crush zone in Cave Creek on the east, several bodies of ironstone occur. The largest crop (at the Caves) is 300 ft. wide tapering down to less than 100 ft. at the western extremity. The eastern end is rendered conspicuous by its towering 100 ft. above the creek.

Reference to the occurrence and composition of these iron ores will be found elsewhere.

There is a probability that all the above strata are of the same age, the shear-zone, crush-zone, and faults being due to the forces which produced the geo-syncline, and the induration being due to earth pressure and cementation by deposition of silica from circulating solutions.

The Mount Oxide ore-bodies are thus located on the fractured edge of a syncline, where ground waters have had full scope to circulate.

Mount Oxide (M.L. 282).

The main shaft* was begun in country rock (slate decomposed into ferruginous kaolin internally slickensided), 5 ft. east of a body of carbonate and oxychloride, which was cut at 20 ft. from the surface. The bottom of the shaft is wholly in ore, the footwall of the deposit not yet having been met, owing to a steepening of the dip as depth increases. The hanging-wall is very irregular and ill-defined. The ore from the shaft, consisting of carbonate, oxychloride, and oxide,

* Reports came to hand towards the end of 1907 that the shaft had been sunk 74 ft. and crosscuts were then opened 25 ft. west and 17 ft. east, the former in 5% ore the latter in 42% ore. No confirmation has, however, yet been received of this.

contains as impurity only from 20 to 30% of clay, indicating replacement of decomposed country.

FIG. 25.—MAIN SHAFT, MOUNT OXIDE. [*L. C. B., photo.*

The same ore-body has been exposed by open-cutting, over a distance of 20 ft., to within 15 ft. of the shaft, the face there being 6 ft. in width, and in the centre of the cut it is 8 ft. wide. At the shaft the crop is only 5 ft. wide, and thence tapers out within 20 ft. to the north.

Between 25 or 30 tons of ore now lie stacked at the shaft, ready for bagging. My sample, taken from the surface of this heap, contains crystalline atacamite, both with and without interstitial earthy red oxide of iron; crystalline atacamite, between laminæ of kaolinised schist; and earthy malachite and red oxide (tile-ore), with crystalline atacamite drusy on the walls of cavities. The following is its analysis (Government Analyst):

Copper	...	...	= 38·6%	
Gold	...	...	= 19 gr.	per ton
Silver	...	...	= 1 oz. 18 dwt.	,,

The 15 tons of seconds, at grass, containing a large amount of atacamite (acicular and green), probably run 20% copper.

The body continues on the west of a silicified gossany crop for nearly a chain south of the opencut, the amount of copper rapidly decreasing. About 2 ch. south of the cut, is silicified slate highly

stained—but only on the surface—by green carbonate. This forms the footwall country of a very ferruginous, sometimes gossany, body of silicified slate, which may be found to carry occasional bunches of copper ore in depth.

Some 20 ft. north of the main shaft there is a crop, 2 ch. in length, of iron-stained silicified rock, on the eastern side of a thin belt of copper-stained schistose slate, in which quartz lenses have segregated. North again of these crops silicified crushed schist and quartzite, 30 ft. wide, rise above the surface for nearly a chain.

In appearance the crop much resembles the Chinaman, on Duck Creek, except in that, though so siliceous, it contains few bunches of pure quartz. This crushed country contains copper, but seldom to the amount of 10%, though the surface is generally green painted.

The body has been left exposed, for a height of 30 ft. on the east, by the denudation of the adjacent country and it could therefore be easily tested by an adit, but instead a shaft has been begun a few feet north-east of the cliff to catch the body on the underlie.

North of the shaft, the cupriferous portion is only 3 or 4 ft. thick, and it thins out altogether within a chain.

Towards the southern boundary of the lease the footwall schists are strongly stained by blue and green carbonates, over a width of a chain, the slates, both east and west, being both ferruginous and siliceous.

Mount Oxide No. 1 East (M.L. ?)

In the northern part of the lease, on the eastern side of the creek and about 5 ch. north-east of the Caves, is an area of broken, silicified, cherty country (altered shales), stained and veined with malachite over a width of 12 ft. and a length of 30 ft. The copper contents are certainly less than 5%, and it was not thought worthy of sampling.

Another crop of silicified shale, with slight stains of copper carbonate, lies east of the Caves.

A great part of the ironstone crop, described elsewhere, is included within the lease, but no work has yet been done on it. A rough computation of the amount of iron ore above the level of the creek places it at over a million tons.

Mount Oxide No. 1 North (M.L. 333).

No work whatever has yet been done on this lease, though the silicified crush-zone can be traced through it from south to north.

A crop of ironstone a few chains in length lies near the centre of the lease.

Another crush-zone, an extension of the Cave Creek fault, traverses the north-eastern corner of the lease, and here stains and fillings of malachite and tile-ore are found in crushed, ripple-marked, indurated sandstone, the grade of which is very low.

Mount Oxide No. 2 North (M.L. 543).

The crush-zones continue through the south-eastern corner of this lease, and slight stains of copper ore are visible.

Mount Oxide No. 1 South (M.L. 350).

The quartzites and schists of the main crush-zone crop through this lease, the latter, however, pinching out towards the south. The schist is rather gossany and sometimes contains stains of malachite. It is covered to some extent by talus, and no work has been done on it, but an adit has been begun on the western side of the ridge, ½ ch. from the northern boundary, and this is intended to intersect the schist, 50 ft. below the crop.

Mount Oxide No. 2 South (M.L. 544).

A belt of silicified country traverses this lease from north to south, and a shaft has been sunk in the footwall country in the south-western corner, but no copper has been found.

MOUNT GORDON GROUP.

Mount Gordon is located adjacent to Oxide Creek, 2 miles north-north-east of Mount Oxide, and overlooks the Burketown road and Alsace bridle-track.

Four leases are in force here: Mount Gordon (M.L. 597), Mount Gordon No. 1 North (M.L. 598), Mount Gordon No. 1 South (M.L. 599), and Mount Gordon No. 2 South (M.L. 600)—each of 10 acres.

No work has been done on any of them except M.L. 597, and the ground was quite deserted during my stay in the district.

Mount Gordon (M.L. 597).

Location.

This lease is situated on the southern side of Oxide Creek.

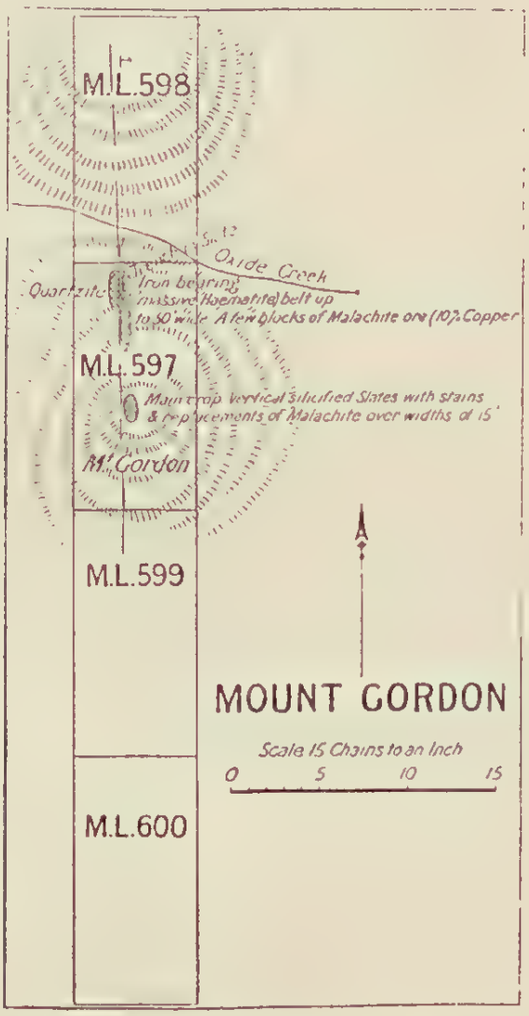
Development.

A trench, 6 ft. long, 3 ft. wide, and 1 ft. deep, has been opened in the northern portion of the lease but failed to locate ore. No work has been done on the main crop, which should first be examined by trenching; and then if indications warrant it an adit might be opened,

either from the north or south, along the cupriferous zone. Alternatively a shaft might be sunk on the crop itself and crosscuts opened at various depths.

Ore-bodies.

No lode has been found here, the copper ore occurring in patches, in a north and south belt of siliceous slates, together with much hæmatite. The copper ore in the main crop on the hill-top, near the centre of the lease, is chiefly malachite, which occurs in veinlets both on the bedding planes and in joints, and also disseminated in the solid country rock, which has a greenish tinge when broken. Carbonates are especially well developed at one spot, where the quartzite has been crushed in a similar manner to parts of the Chinaman crop at Duck Creek.



Much of the stone has a superficial staining of carbonate, which has been leached out from the interior, and gives an altogether erroneous idea of the value of the stone, on a cursory examination.

The copper ores occur in the slates over widths of up to 15 ft., but the richest patches seldom carry as much as 10% of copper.

APPENDIX.

BURKE RIVER (Continued).

MOUNT BIRNIE GROUP (Continued).

Mount Birnie (M.L. 686, Etc.).

Since the above was written, Mr. Harrison, of Boulia, has sent me a collection of specimens from the mine. From these it is inferred that the country in which the ore-bodies occur consists of hornblendic schist. In the crop at the main shaft (since deepened), cuprite is found, gradually shading into limonite and coated with chrysocolla. At shallow depths earthy malachite, sometimes intimately mixed with chalcocite, is found, and at 30 ft. beneath the surface massive metallic chalcocite, carrying crystals of pyrite, appears. Masses of chalcopyrite occur in the schist between 54 and 86 ft. depths, being accompanied by leached pyrite and coated with earthy chalcocite for the lowest 10 ft. (where the body is 3 ft. wide).

Rich specimens, showing intimately mixed chalcocite, malachite, and limonite, sometimes with coatings of chrysocolla, have come from Nos. 2, 3, 5, 6, 7, and Green's shafts, metallic chalcocite from 10 ft. depth in No. 7 shaft also exhibiting disseminated chalcopyrite.

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THE GREAT FITZROY COPPER AND GOLD MINE,

MOUNT CHALMERS (ROCKHAMPTON DISTRICT).

WITH 15 PLATES.

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The Great Fitzroy Copper and Gold Mine,

MOUNT CHALMERS (ROCKHAMPTON DISTRICT).

INTRODUCTION.

Mount Chalmers is the name given many years ago to an old mining locality situated about ten and a-half miles directly north-east of the City of Rockhampton and close to the Emu Park Railway Line. The nearest railway stations to it are New Zealand Gully and Tungamull, the former being fifteen miles from Rockhampton and about four miles from the Fitzroy Copper Mine, the road between the station and the mine being a fairly good one. Tungamull is eighteen miles from Rockhampton and about three miles from the mine, the station and the mine being connected by a bush track. The mine, roads, railway stations, etc., are shown on the accompanying Locality Plan. (Plate 1.)

Close to Rockhampton, on the north side of the Fitzroy River, are the lofty Berserker Ranges, and at the base of these mountains, on the northern side, is Nankine Creek, the stream which separates the Mount Chalmers country from the Berserkers.

Nankine Creek is one of the branches of New Zealand Gully and drains the country about Mount Chalmers, but it is an insignificant watercourse, and although a swollen torrent in wet seasons, does not usually carry much water, and frequently is dried up altogether.

Some of the hills near the mines have very steep slopes, and offer very fine sites for metallurgical works should it be found desirable to erect plant for the treatment of the ores in the vicinity. There are other localities close to the mines where the ground is gently undulating, and where natural advantages exist for limited water conservation in the construction of dams across the gullies and creeks.

Facilities for railway construction also exist between Mount Chalmers and the Emu Park-Rockhampton Railway Line, and easy gradients can be found from either Tungamull or New Zealand Gully to the top of any metallurgical works which might be built on the hill-slopes near the mine. Connections with either of these stations also establishes ready access to the Fitzroy River, as the railway passes close to the northern bank.

The general position of the surface works at the mines, and the topographical features in the immediate vicinity, are shown on Plate 2. The altitudes represented by red contour lines on that plan are from aneroid measurements, and are, therefore, only approximately correct.

GENERAL GEOLOGICAL FEATURES.

The rocks at and around the mines at Mount Chalmers belong to the Gympie (Marine) Series of the Permo-Carboniferous System, and comprise shales, quartzites, and interbedded dolerite. About a mile to the north-west, at Mount Warminster, the rocks consist of shales, quartzites, dolerite, and serpentine, the two latter apparently interbedded with the two former. To the east and north-east of Mount Chalmers there are shales, dolerite, and ferruginous sandstones, closely associated, and perhaps interbedded, with serpentine and fossiliferous limestone.

The neighbourhood of the Mount Chalmers mineral deposits seem to be a region where considerable alteration has taken place in the rocks, both in structure and composition, while at some distance away, more particularly to the east of Mount Chalmers, the sedimentary beds have been subjected to less alteration, the limestones which occur there, and which contain well preserved marine fossils, only being slightly changed.

At Mount Chalmers there are outcrops of an altered greenish felspathic rock exposed close to the mine, and on the low ridges in the neighbourhood some of the outcrops show the rock to partake of the character and composition of a dolerite. With the dolerite there are clay shales and barium-bearing shales, the three rocks being interbedded with one another, the whole, as a series, having the same trend and dip as the boundary walls of the copper-gold deposits.

The barium shales are somewhat irregular in stratification and are generally much decomposed near the surface. The barium is in the form of both sulphate (barytes) and carbonate (witherite), the shales sometimes containing as much as ten per cent. of these minerals, although usually in much smaller quantities. Zinc and lead are always associated with the barium, and where the barytes or witherite occur below the surface, there the zinc sulphide (blende) and lead sulphide (galena), or their decomposition products, are also to be found.

The quartzites, where they are interstratified with the shales, form beds varying in thickness from a few inches to several feet. From an examination of the specimens collected on the surface of the mine and in the underground workings, the quartzites appear to have once been either limestone or fine-grained calcareous sandstones, and at the time the replacement of carbonate of lime with silica was taking place to form the quartzite, the metallic minerals were being deposited from solution.

The quartzites also occur as large massive outcrops, being, in part, the ore body of the Fitzroy Mines. In this case they are, apparently, the result of the alteration of an immense lenticular mass of coralline limestone, although, it must be admitted, there is a total absence of any unaltered limestone deposits in the immediate vicinity. Limestones

occur at Tungamull, a few miles to the east of the mines, interbedded with rocks similar to those associated with the quartzites at Mount Chalmers, but, unlike the latter, have not been subjected to such alteration.

Where the rocks in the Mount Chalmers-Berserker mineral area are much altered it is noticed that limestones are absent, except as small veins of recent formation, yet the fossils in the greenish felspathic sandstones in and around the Berserkers show that the rocks there have been formed under marine conditions and that limestones may once have existed there. Hand specimens of the quartzites show structure very like that of limestones which have been partly changed into silica, and Fig. 1, which is a reproduction of a weathered specimen of quartzite from Rankine Hill, at Mount Chalmers, well illustrates this structure. The white portion in the illustration is quartzite, and the effect is due to the alteration of the limestone by the infiltration of silica along the bedding and joint planes, the other portions being weathered away.

In the Fitzroy Mines the quartzites have been found to merge into a rock mostly made up of silica, with a small proportion of metallic sulphides, and this in turn has imperceptibly been changed into massive sulphide ore with a comparatively small proportion of silica. It is the latter class of ore which contains the high values in copper, while the quartzites, approaching the other extreme, gradually loses its cupriferous character and becomes more defined as a gold-and-silver ore. If the quartzites have been formed by the replacement of limestone by silica, and if they gradually merge into sulphides, then the whole of the mass, it may be assumed, was originally limestone.

There can be no objection in assuming that one portion of a large mass of limestone is replaced by silica, and that the other portion is changed to metallic sulphides, but there is a probability, in the Fitzroy Mines, that whilst the quartzites are derived from limestone, the sulphides are due to the alteration, not of the limestone, but of extensive beds of serpentine. At Mount Warminster a bed of serpentine rests on the cupriferous clay shales now being worked there for copper, and where this bed is exposed in one of the watercourses near the mine workings it presents certain characters closely resembling those of the sulphide ore-body at the Fitzroy Mines.

The Warminster serpentine is, as a whole, very compact and without stratification, but parts of it are finely foliated where there are present rounded fragments and masses of a bright red jasper, the lines of foliation conforming somewhat with the shape of the jasper inclusions. The jasper is exclusively confined to the serpentine, and is conspicuous and abundant where the serpentine is of a finer quality, and seems to be a product of alteration of the rock from which the serpentine itself was formed.

The whole of the above paragraph (with the exception of the latter portion of the last sentence, and if the word *serpentine* be replaced by the words *copper-iron sulphides*) might also describe the characters of the sulphide ore bodies at the Fitzroy Mines. There is the same massive appearanace and the same foliation around the bright red jasper, and there is also a better quality of ore where the jasper inclusions are present than where they are absent. These features, when taken in conjunction with the fact that a slaty serpentine occurs close to the mines, and that the ore body contains magnesia, suggest the probability that metasomatic action has produced the sulphides by the replacement of serpentinous matter. Fig. 2, on page 8, is a reproduction of a hand specimen of copper ore from the northern end of the workings in the Fitzroy Mines, and shows the foliation of the sulphides around the jasper inclusions. The same figure might also be taken to represent a specimen of the serpentine at Mount Warminster containing red jasper.

Dyke rocks at Mount Chalmers have been met with in several of the mine workings, and have been proved to occur both in the ore bodies and in the adjacent country rocks. At the northern end of the workings the dykes appear to have a general north-west and south-east trend, and are nearly vertical, but developments may alter this aspect of their behaviour, and they may be found to consist of a network of intrusions, varying in thickness from a few inches to several feet. The workings on the southern end of the mines have also revealed similar intrusions, but their characters have not yet been defined. The dyke rock always occurs as a bluish-white clay, not yet being observed undecomposed, so its original mineral constitution is unknown. Later developments at lower levels in the mines will, no doubt, reveal it in its primitive condition.

In the quartzites exposed in the Adit Level there are seams of clay in the joint planes which appear to be decomposed dyke rocks, but whether they are such, or the infilling of clay derived from the rocks above cannot be determined. The latter is probably the case in some instances, as in wet weather there is a constant stream of water passing through these joints, bringing down sediment, while on the other hand some of the clay appears to have been dyke rock decomposed *in situ*.

The joint planes just referred to form part of a series of minor dislocations whose direction is fairly uniform throughout the workings, and they are conspicuously developed in the quartzites in the lower workings at the southern end of the mine. Some of the workings in "A" shaft show the joints to be at a small angle with the bedding planes, while in other places they are parallel with the strata. Faults sometimes exist along these planes, movements evidently having taken place both along and obliquely across the lines of bedding. The study of these joint-planes are useful in many ways in conjunction with mining development, but there may be some

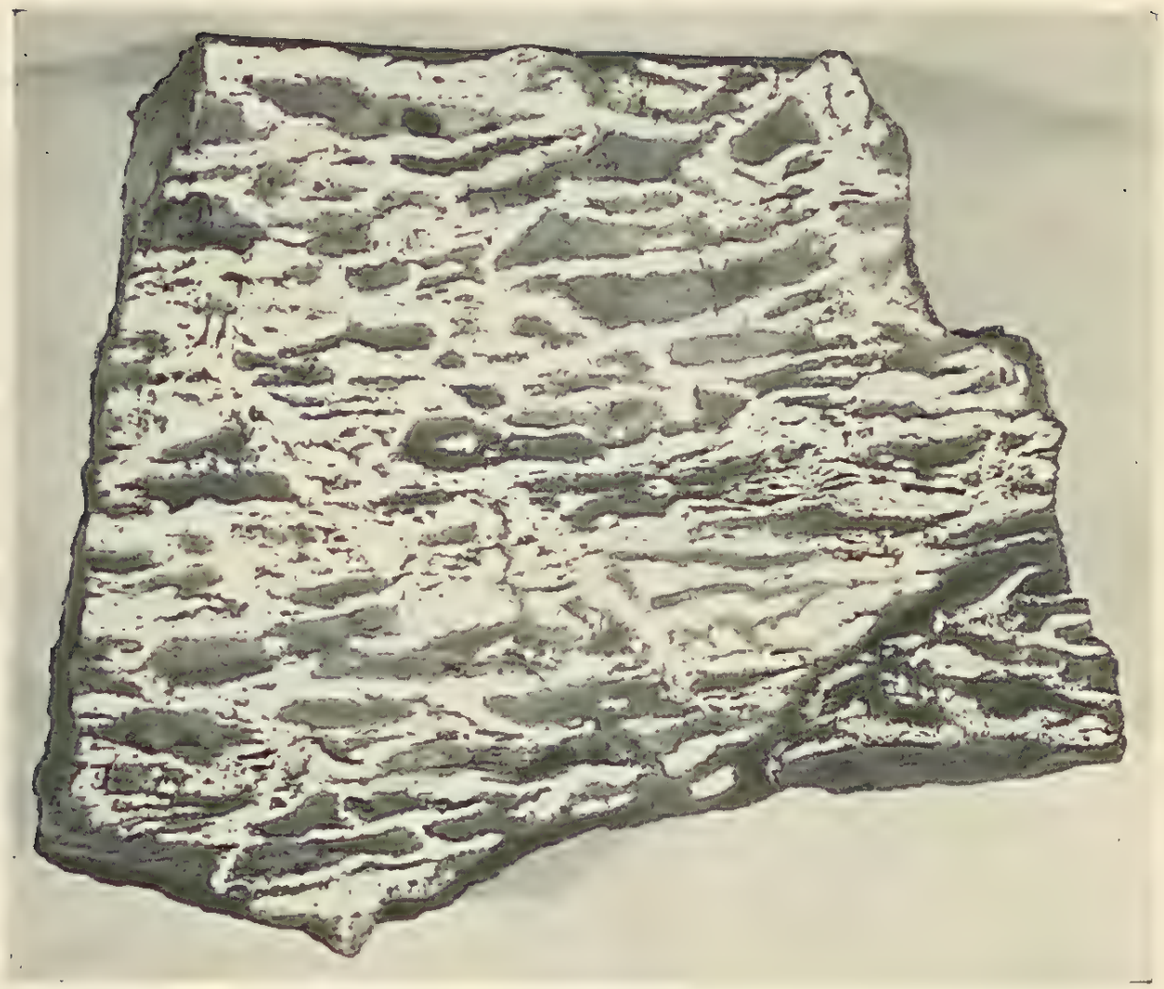


FIG 1.

SPECIMEN OF QUARTZITE FROM RANKINE HILL, MOUNT CHALMERS.

Showing the formation of veins of silica along the joints in the rock.

FIG. 2.

SPECIMEN OF COPPER ORE FROM THE NORTHERN WORKINGS, FITZROY MINE.

Showing the sulphides (white in the illustration) foliated around the jasper inclusions.

tendency to consider them, exclusively, as bedding planes in agreeing with the strata in angle of dip, and closely with them in direction of strike, and unless they are carefully watched as the work proceeds there will always be the chance of following them into poor country. The lode is not always to be distinguished from the adjacent rocks, and is frequently quite barren, and in following a joint plane instead of a wall or bedding plane a needless amount of work might be entailed.

The rocks exposed in the workings of "A" shaft show that the country has also been disturbed in a way quite distinct from the movements that produce joint planes, the result of which is shown in the breaking up of the quartzites into innumerable fragments. This character of the quartzites in the "A" shaft workings is due simply to irregular crushing movements in the rock masses, and not to weathering agencies as has been suggested. The breaking up of the quartzites into fragments makes the beds very friable, the latter having a tendency to crumble away in the old workings where clayey matter has accumulated in the fine crevices between the fragments.

The weathering action taking place in the rocks and in the ore bodies close to the surface has produced several changes in their composition. The iron pyrites contained in the quartzites have become oxidised, giving to the rocks a reddish colour, and where the quantity of this mineral in the quartzites has been great the oxidation has produced a ferruginous gossan. In the Adit Level this gossan occurs in large quantities, other localities where it is found being in the upper workings in the East Shaft, and the surface workings on the outcrop of the quartzite in the triangle formed by the North Shaft, "A" Shaft, and West Shaft. The gossan does not contain copper or zinc, or any sulphide ore, and the gold contained in it is probably in a favourable condition for easy recovery.

Where the quartzites are not ferruginous they are frequently mixed with a whitish clayey substance derived from the decomposed clay shales in the vicinity. This clay is generally kaolin, but is sometimes mixed with greasy talcose material.

It has been a cause of surprise that the occurrence of large bodies of copper ore, as revealed in the workings, was not indicated by any defined surface features. The quartzites which contain the gold on the surface do not carry copper, except in traces, although, as stated, the porous nature of some portions of the lode shows that mineral of some kind has been weathered out of the stone. Having these favourable indications as a guide, a large amount of prospecting for gold has been carried out at various times. The total absence of copper indications, at least on the northern end, is accounted for by the fact that the large body of sulphide ore has never been exposed on the surface, that in this part of the lode the quartzites form a hard and compact outcrop, which has not only itself withstood

all weathering action, but has to a great extent prevented the oxidation of the sulphides occurring just below. Taking all the circumstances into consideration, no doubt much of the development which has been instrumental in proving the large copper-gold deposit would not have been undertaken if it simply depended on geological indications, so that its discovery must in a great measure be credited to the personal endeavours and convictions of those who undertook the work.

LIMITS OF THE ORE DEPOSITS.

The workings at the northern end of the mines have disclosed well-defined walls of clay shales in marked contrast with the adjacent ore deposits, and leave no room to doubt that the limit of the sulphides there has been reached. In the top (adit) level the northerly workings exposed a wall having an inclination to the north at about an angle of forty degrees. This wall has been traced to the eastern side, being found in the workings close to the north shaft, and also further south at the winze, where it was followed down on the underlie to a depth of forty feet. The angle of inclination of the wall at the Adit Level is about sixty degrees from the horizontal, but in the winze the dip is less, gradually flattening to an angle of thirty degrees at the bottom. The eastern workings on the same level are all in quartzite, and a wall has not yet been found. These features are shown on Plates 3 to 9.

No. 1 (120 ft.) Level has not been sufficiently extended to expose a wall, but No. 2 (150 feet) Level has been driven northerly into massive sulphides, meeting at the end a wall of country rock having a north-easterly inclination. The wall has also been found in a cross-cut driven to the west, and in the eastern cross-cut there is a continuation of the same wall, having the same north-easterly inclination. The wall at this level will probably be found to have the trend shown in dotted lines on Plates 3 and 7, and the inclination as shown in the sections on Plates 4 and 5.

In the West Shaft Workings the geological features are not well defined. From an examination of the two levels put in towards the south-east, it is evident that neither the large sulphide ore body of the northern workings, nor the quartzites of the "A" shaft have been touched, and also that the West Shaft workings are separated from those deposits by beds of altered sedimentary rocks. Quartzites with sulphide ore are present, but they are probably small beds interstratified with the clay shales and the barium shales which extend southerly from the West Shaft to the "Windlass Shaft."

The inclination of the strata exposed in the West Shaft workings is not well marked, and there is here much confusion between the joint planes and the bedding planes, a remark which also applies to the rocks about the "Windlass Shaft." At the same time, it is evident

that the beds at the two above-mentioned localities conform with the inclination of the massive quartzites which occur easterly and south-easterly from them. This is illustrated in section on Plate 5.

The old surface workings to the west of the Adit Level are all in ferruginous quartzites, and No. 1 Shaft, and also the open-cut leading into it from the south, have shown that the clay shales resting on the quartzites have a dip to the north-east. This dip becomes easterly where the shales are exposed a little further to the south, and westerly a short distance to the east, the easterly and westerly dip together forming a syncline. The quartzites also conform with this change of inclination of the shales above them. Following the surface features from the syncline at the No. 1 Old Workings towards the north-east, it is apparent that the shales connect with similar strata met with in the workings in the Adit Level.

The trend of the shales from No. 1 Shaft appears to be towards the north-west, then they turn around to connect with the shales in the western workings, the dip changing from north-east to north, and then to north-west.

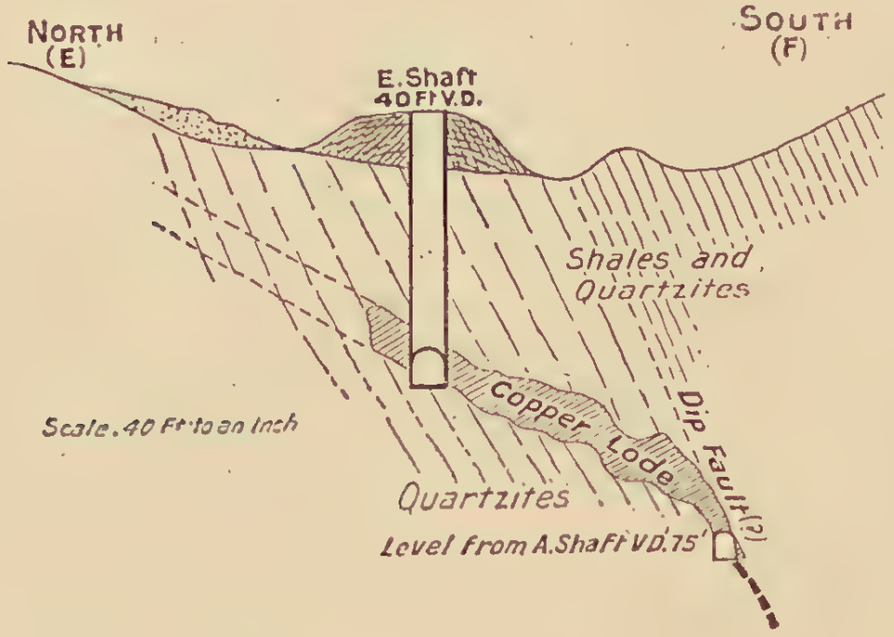
The depression of the quartzites in the synclinal fold divides the lode into two great lobes, the probable configuration at the various depths being represented on the Plate 3 by dotted parallel lines, while their probable direction of dip is represented by arrows. These features are also shown on Plates 4 and 5, the dotted lines representing, in section, the synclinal foldings and the probable dip of the lode in the direction of the West Shaft.

The clay shales on the surface near the North Shaft follow the quartzite outcrop around towards the east, and the eastern contour of the quartzites, dipping easterly, is probably the limit of the ore body at this level, the watercourse here being close to the junction of the quartzites and the clay shales. Following this watercourse around the quartzite outcrop in a southerly direction, the shales are found to be exposed in the workings of the East Shaft, their general character and behaviour being similar to those at the western workings, but having a dip to the southward.

Between "A" Shaft and East Shaft the underground workings indicate that the quartzites and shales are undulating, and vary in direction of dip, but that they have a general southerly inclination of about 45 degrees, as shown on Plate 4 and Fig. 4. On the surface there are beds of quartzites, shales, and slaty serpentine exposed in the excavations near "A" Shaft, having the same behaviour as the rocks below. The trend of the quartzites continues regularly to "A" Shaft, which then changes to the north-west, the workings showing very decidedly this to be their direction. The wall exposed in the drive to the south of "A" Shaft partly traverses the line of junction between quartzites and shales, but in the western end there is evidence to show

that this wall is a fault-plane, although agreeing partly with the bedding plane of the strata. To continue the workings in this direction would result in meeting with country that is not mineral-bearing.

Fig. 3.



SECTION ACROSS EAST SHAFT (ON LINE E.F. ON PLATE 3).

Showing the copper lode, the dip fault (?), and the general southerly dip of the quartzites.

From the north-western workings of "A" Shaft, the quartzites must turn very sharply to the west to conform with the fold at the No. 1 Old Workings, and also with the outcrops further west, and they must then gradually curve round to meet the quartzites close to the Windlass Shaft, the dip of the rocks changing from south to south-west, and then to west. The plan of the workings on Plate 3, and the vertical sections on Plates 4 and 5 will illustrate the mode of occurrence of the ore deposits, which, with the description given above, will show that there is very little more to do to prove that the Great Fitzroy copper-gold ore bodies are limited in their surface extension.

At the time of the writer's examination of the Great Fitzroy Mine a certain section of mining speculators took exception to his decided condemnation of a report that was being circulated, to the effect that the Fitzroy Copper Lode extended in a westerly direction and that it would be found outside the areas held by the Fitzroy Company. The above particulars will explain why that condemnation was made, and will also show that the action in attempting to stop capital being raised for useless surface prospecting purposes was quite justified.

Regarding the vertical limit of the ore bodies, no opinion can be expressed concerning the depth to which the sulphides extend, as in the deepest workings neither wall nor country rock have been met with, but the surface and surrounding features indicate the ore body to have a general dip in all directions away from a centre, and that it forms roughly the upper portion of a double-lobed or lens-shaped mass. Plate 4 illustrates the contact of the ore body and the country

rock at the northern end, and also the northerly inclination here of the line of contact, the same illustration showing the southerly dip of the quartzites in the workings connected with "A" Shaft. There is a probability that the under side, when found, will have a shape corresponding in many respects with the upper side, and this view will agree with the opinion previously expressed, that the ore bodies might be the result of alteration of serpentine and coralline limestone.

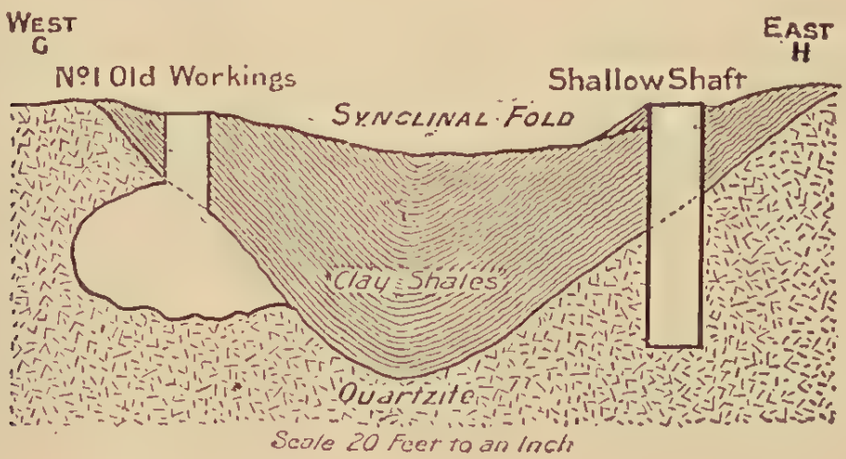
MINING DEVELOPMENTS.

The surface workings at Mount Chalmers were started about forty years ago, when the outcrops of gold-bearing quartzite and gossan near the adit level were opened up. Since that time there has been a considerable amount of prospecting work carried on in many parts of the property.

The portion of the workings referred to herein as No. 1 Old Workings comprises shallow shafts, open-cuts, trenches and irregular excavations in ferruginous quartzite, all of which have been worked for gold. The stone appears to have been mineral-bearing, but all the sulphides have disappeared, and the gold has been left behind without the presence of even a trace of copper.

The quartzites and the overlying shales are exposed in a cross-section in these old workings, the synclinal depression or fold, with a north and south axis and a sharp inclination from the east and west, being well shown. A section of the No. 1 Old Workings is shown in Fig. 4.

FIG. 4.



SECTION ACROSS NO. 1 OLD WORKINGS.

Showing the synclinal depression in the quartzites and clay shales.

In the compact quartzites to the east of No. 1 Old Workings there occurs a belt of ferruginous rock several feet wide, evidently once very much mineralised. This has been worked in an open-cut, and several tons of stone, said to contain from four dwts. to fourteen dwts. of gold per ton, have been removed and crushed in a local

battery. The open-cut extends south-easterly across the mouth of the Adit Level to an old underlie shaft, now covered up, the shaft being connected with the stopes in the eastern workings. A large quantity of oxidised stone from the stopes to the east of this old shaft was treated for gold many years ago, but the yields at that time were not sufficiently satisfactory to warrant the work being continued without cheaper methods of mining and milling, although the gold-bearing stone removed must have had a width of several feet. Plate 3 shows the position of the open-cut, the stopes, and the old covered-up shaft.

The workings at the bottom of the East Shaft, and also those connected with this shaft below this level, have been worked for copper, and the ramifications therein show that the cupriferous quartzites, while occurring irregularly, have been sufficiently rich to pay for costly mining. There is a large body of semi-oxidised stone exposed here which should yield a considerable amount of payable copper ore, and from the appearance of the various working faces it is evident that the body of stone continues further north-east and south-east.

Fig. 3, page 12, represents a section of the East Shaft Workings, showing the relation of the copper lode to the associated rocks and the probable upward extension of the lode to the surface near the mouth of the Adit Level. Its limit at the fault-plane in the 75-foot Level from "A" Shaft is also indicated in the figure, this level, at its eastern extension, forming the bottom workings of the East Shaft.

The drive connecting the "A" Shaft workings at the 75-foot Level with the East Shaft lower workings is partly closed with débris from the East Shaft stopes, but sufficient is exposed to indicate that the copper gradually disappears from the quartzites as they extend westerly from the eastern workings. It is probable, however, that the "A" Shaft, above the 75-foot Level, passed through the same character of formation as that carrying the copper, and this suggests the possibility of a continuation of the lode above the drive south of the "A" Shaft, the lode rising up towards the surface to the north and outcropping near the watercourse south of the No. 1 Old Workings.

The general character of the country explored by the numerous drives from the "A" Shaft indicates that at the 75-foot Level a large body of quartzites exists which contain so little gold that it may be considered absolutely worthless. There are, however, several occurrences of copper ore in these workings just sufficiently rich to give a little encouragement for further exploratory work.

Close to "A" Shaft a "rise" has been put up for thirty feet into good copper ore, where the developments show that the ore body is probably connected with the lode occurring in the eastern workings and also with the continuation of this same lode which, as suggested, might exist west of "A" Shaft. A winze in the level south of "A" Shaft has been sunk to a depth of a few feet, where some good copper ore has been exposed, whilst the chamber in the drive west of "A" Shaft has yielded some payable gold-bearing quartzites.

A small vein of black copper oxide has been followed along the north-western drive from "A" Shaft, and in the same drive (*see* Plate 3) a short "rise" has been put up to follow some partly-oxidised copper ore. The northern drive has passed through a large body of poor quartzites, and is evidently in the same series of quartzites which are exposed at the open-cut near the mouth of the Adit Level.

The Adit Level has been driven in an irregularly northern direction for 320 feet, and has passed through a large body of ferruginous quartzites carrying small quantities of gold. Near the mouth of the tunnel the rocks on one side contain a little copper ore, which, as stated previously, is evidently an upward extension of the copper-bearing lode in the eastern workings.

The cross-cut put in to the east at 195 feet from the mouth of the tunnel, known as the "Ballroom," has been proved to contain payable stone, and 265 tons removed from the chamber at the end of the cross-cut have been treated, it is said, for a return of nine dwts. per ton. The stone exposed in this part of the mine contains gold varying from two to seven dwts. per ton, but this did not offer sufficient inducement, under the old conditions, for continuing the work.

The cross-cut on the west side of the Adit Level is in lode material similar to that found in the "Ballroom," but it also contains a red jasper, with carbonate of barium (Witherite), sulphate of barium (Barytes), and carbonate of lead (Cerussite). Assays which have been made prove that the stone in this cross-cut contains traces of gold and from six to seven ounces of silver per ton.

The winze at the end of the western cross-cut on the boundary of the ore body has been sunk to a depth of forty feet, and has revealed a tendency of the wall of clay shales to change from a steep angle of inclination to one comparatively flat. This is illustrated in the section on Plate 5. The wall in the vicinity of the winze is probably undulating, and so both steep and flat portions may be expected to occur alternately.

Along the Adit Level beyond the cross-cuts, the ferruginous quartzites have been proved to continue uninterruptedly. Assays which have been made of samples taken from every portion of the drive between the "Ballroom" cross-cut and the eastern cross-cut opposite the North Shaft, a distance of sixty-six feet, and also of samples from the latter cross-cut itself, average, according to the management, three dwts. of gold to the ton, and traces of silver. The cross-cut also exposes copper ore, but in negligible quantities and values.

The quartzites in the western cross-cut—*i.e.*, between the eastern cross-cut and the North Shaft (*see* Plate 3)—have been tested by a bulk sample, and five tons which was sent to Ballarat by Captain Osborne, yielded five dwts. of gold per ton.

The Adit Level is extended further north of the last-mentioned cross-cuts, and after passing through about forty feet of quartzites, and meeting with a wall of clay shales, is then continued to the north-east and then to the east, keeping the wall on its northern side, the total distance from the last-mentioned cross-cuts being about eighty feet. No data are obtainable showing the results of any tests of the stone from this end of the Adit Level.

The shale wall exposed at the northern end of the Adit Level trends towards the south-west, and, as shown in Plate 3, probably junctions with the wall found close to the North Shaft and also found in the winze further south. The dip of the shales at the northern end is at an angle of sixty degrees to the north, but while the direction of dip varies as the direction of trend or strike, the angles of dip observed in this level are found to be fairly uniform.

The North Shaft has been sunk to prospect the sulphide ore-bodies at the northern end of the mine, and has reached a depth of 220 feet. The Adit Level is forty-five feet from the surface, below which there is No. 1 Level at 120 feet, No. 2 Level at 150 feet, the Intermediate Level at 182 feet, and No. 3 Level at 204 feet. All the levels are connected with the North Shaft, and with the exception of the Adit Level, all are driven into sulphide ore containing copper and gold. The position of the shafts with regard to the levels are shown in plan on Plate 3 and in section on Plates 4 and 5.

No. 1 Level, at 120 feet below the collar of North Shaft, has exposed a large body of ore in the workings, most of which consists of iron pyrites in quartzite, with associated quartz veins and red jasper masses. The copper contents of portions of the ore tested at this level average between five and six per cent., but the bulk of the ore has not been estimated, while the gold contents by assay tests are shown to be about two dwts. per ton.

A mass of oxidised ore forty-five feet long, fifty feet deep, and from four to five feet wide, containing native copper, has been taken from a stope between this level and the No. 2 Level, but only traces of the native metal are now to be seen. The assays made by the management show that the ore averaged from six to seven per cent. of native copper, portions of which, however, yielded ten per cent. of this metal.

A large chamber about fifty feet in diameter and extending from about twenty feet above No. 1 Level to the No. 2 Level below, a total distance of fifty feet, has been made in a rich body of mixed sulphide and oxide ore, from which 1,467 tons of oxidised stone have been raised and concentrated, while about 2,500 tons of sulphide ore are now at grass, unfit for water concentration but very suitable for smelting. The workings around the chamber on all sides show that a large amount of good ore is here available for mining and treatment.

Fig. 3 illustrates the workings on No. 1 Level, and, as well as the features referred to above, shows the position of the cross-cut from the western drive. At the end of this cross-cut, a change in the character of the lode took place, and what was thought to be a wall was met with, but which, however, is only a portion of a shale formation, and apparently included in the sulphide ore body as a "horse." The stope in the south-eastern drive where the native copper was taken from is also shown in the figure.

No. 2 Level, at 150 feet below the surface at the North Shaft, has been extended from the shaft in two directions, one drive being south-easterly, the other northerly. The south-eastern drive is, altogether, ninety feet long—the first forty feet being to the east-south-east from the shaft and then fifty feet to the south-east, and having a thirty-foot cross-cut to the north-east at about twenty feet from the face. These workings have exposed a body of quartzites and sulphide ore having a general average value of 4·5 per cent. of copper, with about two dwts. of gold per ton, and one ounce of silver per ton. These results are from the many recorded assays of the stone which have been made at various times.

In the northern drive between the North Shaft and the intersection of the eastern and western cross-cuts, a distance of 190 feet, the ore is sulphides and quartzites, being siliceous and partly oxidised near the shaft, and gradually becoming more basic and showing less decomposition towards the northern end of the workings. The general average assay returns of samples taken throughout this 190 feet show that there is a body of ore here which probably contains 3·15 per cent. of copper, 3 dwts. 7 grs. of gold per ton, and 11 dwts. 3 grs. of silver per ton.

The Western Cross-cut is twenty feet long and the sulphides exposed in it extend westerly to the clay shale wall. A dyke, irregularly traversing the ore in the cross-cut, passes into the clay shales beyond the wall, and being of later formation than the sulphides cannot be expected to have any influence on their richness.

The northern drive has been continued north of the intersection of the cross-cuts, and passed through a small clay dyke at thirty feet, meeting a wall at forty feet. The wall is probably a continuation of that met with in the western cross-cut, and the dyke is assumed to be the same as that penetrated at about forty feet in the eastern cross-cut. The latter cross-cut has been continued in ore on the eastern side of the clay dyke, where, at seventy-five feet, a clay shale wall was met with which has a south-east trend. The drive was then turned in the latter direction and followed the wall up to a break or fault which crosses the country and the ore body in an east-and-west direction. This break seems to be the same as that found in the main drive about forty feet south of the intersection of the cross-cuts, and as the clay dyke is present at both places, probably it will be found to traverse

both the ore body and the country from east to west on the line of fault. These features are shown in plan on Plate 3 and in greater detail on Plate 7.

The gold, silver, and copper contents of the sulphides occurring throughout the eastern and western cross-cuts, and also in the end of the main level north of the intersection of the cross-cuts, have been estimated from a great number of recorded bulk and test sample assays, the general average values being as follows: —

Copper, 5·07 per cent.; *gold*, 8 dwts. 16 grs. per ton; *silver*, 11 dwts. 13 grs. per ton.

The large number of bulk assays which have been made by the management of stone taken from this level indicate, as in the results from other parts of the mine, a remarkable evenness of grade, while test samples which have been stripped by several independent mineral surveyors very closely agree with those bulk assays. All the returns have been averaged, and the results are as quoted above.

The Intermediate Level at 182 feet has been opened out to the north-west and south-east of the North Shaft, and has exposed sulphide ore from one end to the other, the distance between the north-western and south-eastern extremities being about eighty feet. Concerning the north-western workings, the level is driven twenty-eight feet to the north-west, then twenty feet west-south-west, quartzites and sulphide ore with included masses of chloritic rock being met with throughout. To the south-east from the shaft, a level twenty-eight feet long connects with the No. 1 Winze, traversing quartzites containing sulphides. From the winze a cross-cut extends east-north-east for twelve feet, and another cross-cut to the west-south-west for twenty-five feet, both in quartzites, sulphides, and chloritic rock. In the two latter drives the chloritic rock is mixed with a large proportion of quartzite, but nearer the shaft the amount of quartzite present is comparatively small, the change from one condition to the other being imperceptible. The chloritic rock at the north-western workings gradually becomes more siliceous as the distance from the shaft becomes greater until, at the face of the drive, the quartzites again predominate.

The values in the Intermediate Level from the assay of bulk samples by the management and of the stripped samples by other examiners show a sameness throughout, the general averages from the 113 feet of stone exposed along the whole of the workings being as follows: —

Copper, 3·06 per cent.; *gold*, 1 dwt. 16 grs. per ton; *silver*, 15 dwts. 6 grs. per ton.

Further details concerning this level are given at Plate 8, its position regarding the other levels being shown in plan and section on Plates 3, 4, and 5.

No. 3 Level, at a depth of 204 feet from the surface, has further developed the body of sulphide ore, but the drives show that the values have not improved at this depth, the ore being slightly poorer in copper and gold than the ore in the Intermediate Level above.

From the North Shaft a drive twenty-three feet long has been put in towards the west, and a cross-cut from this drive at five feet from the shaft has been extended forty-five feet in a direction slightly west-of-north. On the other side of the shaft there is a drive thirteen feet long, having an east-north-east direction, from which there is a small easterly extension twenty-nine feet long. At the end of this extension a sixteen-foot drive has been put in to the north-east, and an opposite one to the west-south-west for a distance of about twenty feet.

The western drive, and the northern cross-cut from it, have exposed compact sulphides having a comparatively small proportion of quartzites, while in the eastern and southern workings the proportion of quartzites to sulphides is found to be greater.

The values of the ore in No. 3 Level, ascertained by the numerous samplings from the North Cross-cut, the West Drive, the East Drive, the Magazine Drive, and the drive opposite the latter workings, are as follows:—

Copper, 1·69 per cent.; *gold*, 20 grains per ton; *silver*, 15 dwt. 7 gr. per ton.

The averages are representative of the whole of the ore exposed in the level, except the south-eastern extension of the East Drive which ends at the No. 1 Winze, and the drive west-south-west from No. 1 Winze, the ore in both these two workings being very poor. (*See* Plate 9.)

The Western Workings have exposed a series of shale beds quite distinct from the massive quartzites which outcrop further east, and which contain sulphides of copper, iron, and zinc, with carbonate and sulphate of barium. The Windlass Shaft has been sunk to a depth of sixty feet, the upper portion being in clay shales, the lower portion in barium-bearing shales. The latter were followed along the strike for 100 feet (?) in a northerly drive towards the West Shaft, but on account of the drive being filled with mullock taken from the adjoining cross-cut an examination could not be made. This cross-cut has been driven sixty feet to the west, and after passing through a series of clay shales entered a bed of quartzite containing traces of gold and copper.

About thirty feet to the west of the Windlass Shaft the "Red" Shaft has been sunk to a depth of sixty feet (?) but has been filled up to about thirty feet, the two shafts being connected by old underground workings. In these old workings some ferruginous gold-bearing clayey ore is exposed, and from the manner in which portions of it have been selected and removed, while other parts have been

discarded, it is evident that some of the ore has been of a payable grade. The bright-red colour given to the ore by the oxide of iron (hæmatite) has suggested the name by which this shaft is known.

There are other workings about forty feet south of the Windlass Shaft, consisting of an open-cut and shallow excavations, where the reddish shales and quartzites are seen close to one another, both with a defined easterly dip. The quartzites exposed do not contain a payable quantity of gold, and this is probably the reason why so very little work has been expended on them, while the shales which contain sulphide of zinc, lead, and copper have been also neglected because they do not contain high values.

The easterly dip of the rocks observed in some of the western workings does not appear to be constant, and in the filled-in level of the Windlass Shaft the inclination of the rock is said to be distinctly westerly. Possibly there has been some confusion in observing the angle of dip of the shales and of the cleavage planes in the shales in this level, and the beds might be found to have a general inclination to the east, and thus to underlie the massive quartzites in that direction. If this be true, then the direction of dip would be contrary to that shown in the section of the western workings on Plate 5. The effect in the latter case would necessitate the clay shales in the synclinal fold being shown as an outcrop to the east of the West Shaft, and also to the south-east and south of the large outcrop of quartzite between the western workings and the No. 1 Old Workings.

A casual examination of the rock outcrops in the vicinity of the mine show that the dolerite occurs between the West Shaft and the dam further west, and extends southerly to the hill close to the manager's house. It then trends south-easterly to the hill near the manager's office, and thence easterly to the explosive magazine, the trend conforming closely with the strike of the shales around the massive ore-body. (*See* Plate 2). The dolerite is probably a sheet interbedded with the sedimentary rocks, and thus its outcrop west of the West Shaft, and at the other places mentioned, may be taken to indicate a limit at this part of the mine beyond which the ore deposits do not extend.

ORE RESERVES.

The numerous tests which have been made of ore from almost all parts of the mine, form a very good basis on which to estimate general average values of the whole of the ore-bodies, but while the results of this estimate are satisfactory in many ways, the workings from which the test samples were taken do not expose all the boundaries of blocks of ore, and, therefore, the quantities and values herein given must be taken as being only approximately correct.

The ferruginous quartzites in and about the Adit Level, the Open-cut, the No. 1 Old Workings, the upper stopes of the East Shaft, and

the western workings about the Windlass Shaft, are all comprised in the general term "surface workings." They expose many thousands of tons of stone carrying gold in quantities ranging from three to six dwts. per ton, and this amount would probably be increased by many more thousands of tons if additional prospecting work were taken in hand.

The East Shaft lower workings, from which many hundreds of tons of copper-gold ore have been removed, show evidence of the continuation of the copper lode towards the east, and with the stone now in sight on the numerous faces, it is reasonable to assume that a large number of tons of ore will be available for smelting in future. Its extension in depth will probably be limited by the fault-plane met with at the bottom workings extending easterly from "A" Shaft.

The "A" Shaft workings at the Seventy-foot Level have opened up a large block of country, but except in a small way cannot be considered a source of copper ores or of gold-bearing quartzites. The copper ore and the auriferous quartzites which have been removed at odd times only amounts to a few tons, while a very limited number of tons of each are actually in sight.

West Shaft workings have produced some irregular bunches of good ore, made up mostly of sulphides, and they may be expected to continue this irregular production if work here is started again. An estimate of quantities and values cannot be made, as the occurrence of the ore is too ill-defined.

In considering the quantities and values of the ore in and below No. 1 Level, the Plans and Sections on Plates 3, 4, 5, 6, 7, 8, and 9 are requisitioned. In the vicinity of the North Shaft the levels, cross-cuts, and winzes fairly indicate the existence of a body of ore from about forty feet above No. 1 Level to about ten feet below No. 3 Level, the dimensions being 130 feet in depth, eighty feet in width (north-and-south) and ninety feet in length (east-and-west), and containing 1,026,000 cubic feet. Allowing eleven cubic feet to the ton of ore in this block (the ore consisting of about seventy per cent. of the lighter substances, as silica, alumina, lime, and magnesia), the quantity would be over 93,000 tons.

The values in each level in this (No. 1) Block have been given previously, an average of which shows that the 95,000 tons contain 3·4 per cent. of copper, 1 dwt. 13 gr. of gold per ton, and 16 dwt. 6 gr. of silver per ton.

The ore bodies in the northern workings are divided into Blocks No. 2 and No. 3, respectively being above and below No. 2 Level. The ore between No. 1 and No. 2 Levels, it is reasonable to suppose, continues horizontally for some distance in a northerly direction, but if a gradual downward slope of the ore-body from above No. 1 Level to the northern end of No. 2 Level be taken as the uppermost limit of Block No. 2, there will be no possibility of over-estimation. This

slope, together with the vertical distance from the point above No. 1 Level down to the No. 2 Level, and the horizontal distance from a point thirty feet north of the shaft (the northern limit of No. 1 Block) to the northern end of No. 2 Level, will be the triangular sides of what might be expected to be its minimum area in a north-and-south vertical section. The position of these Blocks are shown in red on Plates 3, 4, and 5.

The east-and-west section of Block 2 is taken at the points where the northern vertical face of Block 1 is assumed to be, and the area of this vertical section is a rectangle. The north-and-south triangular area gives an average height of thirty-three feet, the east-and-west rectangular section gives a width of ninety feet, and the distance along No. 2 Level is 165 feet. There are many irregularities to be noticed in defining these limits, and a give-and-take method has had to be adopted, but, all things considered, the dimensions are as near as can be attained in such an approximate estimate. The block contains 490,000 cubic feet, and, having a higher percentage of metallic minerals, and a comparatively low percentage of silica, alumina, lime, and magnesia (under fifty per cent) ten cubic feet is allowed to the ton, from which Block No. 2 is estimated to contain 49,000 tons of ore.

No. 3 Block is contained in the area below No. 2 Block, the lower boundary reaching below No. 3 level, and sloping upwards from this level to the northern end of No. 2 level. It has the same cubic capacity as Block No. 2, and, therefore, is assumed to contain the same number of tons of ore, namely, 49,000 tons.

In estimating values, the southern limit of the two blocks will be of the same value as that of Block No. 1, and so would contain 4·5 per cent. of copper, 2 dwt. 1 gr. of gold per ton, and 1 oz. 1 dwt. 16 gr. of silver per ton. The northern limit will have the average values of the ore at that end of No. 2 Level—namely, 5 per cent. of copper, 8 dwt. 16 gr. of gold per ton, and 12 dwt. of silver per ton. The middle of the block will probably have the average values of the ore along the No. 2 Level between the shaft and the northern cross-cuts—namely, 3·15 per cent. of copper, 3 dwt. 7 gr. of gold per ton, and 11 dwt. 13 gr. of silver per ton. The northern values, being at the wedge end of the block, are given to a quarter of the whole tonnage, while the values of No. 2 Level are given to another quarter, the remaining half, being the thick end of the block, having the values of the adjoining Block 2.

On the above basis the 98,000 tons in Blocks 2 and 3 contain 4·28 per cent. of copper, 4 dwt. 4 gr. of gold per ton, and 16 dwt. 16 gr. of silver per ton, while the whole of the three blocks, comprising 193,000 tons, would contain 3·8 per cent. of copper, 2 dwt. 19 gr. of gold per ton, and 16 dwt. 10 gr. of silver per ton.

The tonnage might be considerably augmented by the ore which continues below No. 2 level at the wall in the northern workings, as the inclination of the ore-body there is to the northward. There is some probability, however, of this wall turning under and dipping in the opposite direction, and therefore it has been deemed advisable not to form an estimate of quantities in this part until some more work has been carried out.

Consideration has been given to the occurrence of unpayable portions of the ore-bodies, and to the probability of some of the ore being thrown out as mullock when the mine is in full working order. If one-quarter of the whole of the tonnage be taken as the portion discarded, there would be, of course, an accompanying loss in copper, gold, and silver, but an increased value to that which is selected; and perhaps a sixth of the whole of the values in copper, gold, and silver, might be put down as loss, while the remaining five-sixths of the values would be contained in the remaining three-quarters of the tonnage. On this basis there would be, roughly, 145,000 tons of ore available, containing about 4½ per cent. of copper, about 3½ dwt. of gold per ton, and about one ounce of silver per ton.

FUTURE OPERATIONS.

The geological details which have been worked out during the examination of the mine, and the views which have been expressed concerning the character of the ore deposits as a whole, fairly show the lines along which prospecting operations should be conducted.

The quartzites in the surface workings do not contain copper in appreciable quantities, and their gold and silver contents must be considered to be low, so for the present their development and treatment may be neglected. When the more important parts of the mine have been exploited and smelting works established, then some action should be taken to have the ore-bodies in these workings tested by the continuation of the present shafts, or by sinking additional ones, or perhaps by means of bores. The latter method will probably be found to be quite suitable, as the quartzites are massive and regular in their occurrence, and their mineral contents are not confined, as in a reef, to narrow limits.

An easterly continuation of the "Ballroom" cross-cut in the Adit Level would meet with the wall followed in the northern and north-eastern workings in this level, where the trend of the wall changed from east to south-east, and in being followed will probably be found to change gradually to a southerly direction.

The East Shaft surface workings might be tested by boring, and the same bores will prospect the extension of the copper deposits easterly from this shaft, and will also help to define the deep eastern boundary of the massive sulphides of the northern workings.

The results at the "A" Shaft workings do not offer much inducement for further exploiting the quartzites found there, neither is it advisable at the present juncture to drive to the north-west to connect with the West Shaft, as the prospecting work required between the two workings can be done by boring. When the sulphides to the north are found to continue deeper, the expediency of connecting the two shafts may then be considered, and also the desirability of sinking "A" shaft to a greater depth, and connecting it by levels with the workings in the northern end.

The shaft could be sunk a further depth of 100 or 150 feet to get through the quartzites which have already been prospected in the north-western cross-cut from this shaft, and driving northerly would then be prospecting in unknown country. To connect "A" Shaft with the West Shaft on the present prospects is not warranted.

West Shaft workings should be left alone for the present, but, subsequently, as the northern workings are sunk deeper, and if the sulphides are found to dip persistently to the west, it might be advisable to drive towards those workings and tap the quartzites which cannot be very far away, as shown in Plate 5. Driving westerly from the shaft will reveal new country, as this will be across the strike, while in following to the north the beds which are found in this shaft, probably the trend will be found to gradually change from north to north-east, and then to the eastward. This latter work, however, cannot be recommended at the present time, as it will be outside the boundary of the massive sulphide ore body.

The Windlass Shaft, by being continued to a greater depth, will meet with the quartzites if these rocks are found to dip westerly, and the presence of sulphides here in the shales indicates that if the quartzites occur at a greater depth, the sulphides which they might contain would be undecomposed. Before any development on these lines be undertaken, the filled-in level at the bottom of this shaft should be opened to see whether the beds have a westerly dip, and, if they are found to be so, will indicate that the deeper the shaft is sunk the further away will be the quartzites. Even if the shales dip westerly, the angle at which they lie might be found to be very steep, and under such conditions it would be better to prospect the quartzites by a deep level from the Windlass Shaft. A further consideration is, that the work of prospecting might be better performed by boring, as suggested above, than by the operations just mentioned.

At the North Shaft driving is to be recommended in most of the levels as a means of prospecting the ore-bodies, the limit of the work depending on the position of the boundary wall. The extension of the workings in No. 1 Level in a westerly direction will be limited to about twenty or thirty feet, as the inclination of the boundary wall in the winze sunk from the Adit Level above, indicates that it will be met with at this distance. In other directions on this level there is no

probability of meeting with country rock until the eastern wall is penetrated, which must be about 200 feet away. These features will be better understood by referring to the sections on Plates 4 and 5.

In the lower levels, as they are extended, the wall to the west may be found to be less inclined, and in further sinking the North Shaft, which offers certain advantages in being retained as the main working shaft, other levels driven westerly might be extended a great distance without meeting the western wall, as the wall possibly exists there horizontally, or might even be turned up to dip in the opposite (east) direction to form a synclinal fold.

The northern wall exposed at the end of the workings in No. 2 Level shows strong indications of dipping to the north, and it is at this extremity of the ore body that prospecting operations should be carried on vigorously. Probably the vicinity of the intersection of the main level with the two northernmost cross-cuts offers the best position for sinking a winze to prove the continuation of the sulphides below, while other favourable spots for sinking are along these two northern cross-cuts. The eastern extension of the cross-cut nearer the shaft should also be carried on to meet the eastern boundary.

Before extending the lower levels in a northerly direction it would be advisable to bore at the northern end of the ore body either from the surface or from the face of No. 2 Level. In the former case the vertical depth to expect to find the ore would probably be greater than the horizontal distance of the site from the North Shaft, as the inclination of the wall is more nearly vertical than horizontal. All the country from the surface to the ore body, being shales, would have to be bored through, and then there would be the chance of missing what was sought, as the wall with its northerly dip might change to a southerly inclination some distance south of the position of the bore.

From No. 2 Level the boring would begin in ore, and a vertical bore should be of immense assistance as a preliminary to driving from the north shaft below No. 2 Level. An inclined bore put down in a northerly direction from the same position would very quickly indicate whether the wall dipping north continued to dip in that direction, or whether it turns under and dips to the south. In the former case the bore would be entirely in ore; in the latter case, after passing through ore for some distance, the bore would pass into the shales known to exist on this boundary. If the wall turned under and dipped southerly, the centre of the ore body would be further south than where it appears to be from present indications, and any information bearing on this point would be useful in modifying proposed developments, even to discarding the North Shaft as the main working shaft. On the other hand, if the northern wall continued to dip northerly, the necessity might arise for putting down another shaft in that direction further on from the "North Shaft."

Reference has repeatedly been made to the syncline exposed at the No. 1 Old Workings, and to the occurrence there of gold-bearing quartzites. A bore put down at a point west of the North Shaft and north of No. 1 Old Workings would define the limits of the ore in that direction, and, although the upper portion of the bore would be in clay shales, the information would be a most useful item in questions concerning future developments.

A bore might also be sunk between the No. 1 Old Workings and the Windlass Shaft, to ascertain if the quartzites in that locality are gold-bearing and, as occurs further north-east, if they are covering a body of sulphide ore. In addition the bore would show if the supposed easterly dip of the western boundary of the quartzites is defined in depth.

To the south-east of the North Shaft a bore in the hard outcrop would give some data concerning the eastern limit of the quartzites, and would probably yield some information about the extension in this direction of the copper lode in the East Shaft workings, and also about the eastern portion of the sulphide ore body in the workings at the North Shaft.

Trenching on the surface to define the dip and strike of the shales surrounding the outcrop of the quartzites is an adjunct to the other methods of prospecting, and is specially applicable to the ore-body at the Fitzroy Mines. The strike and dip of the shales will correspond with the dip and strike of the wall of the ore body, and any marked variation in the direction of the strike and the angle of the dip of the sedimentary rocks will have its corresponding change in the boundary of the ore body. When positions and angles of the dip are known on the surface, a very easy calculation will show where, approximately, the wall will be found below the surface, and thus sites for bores can be determined with some degree of accuracy. This work is so inexpensive, so useful, and so readily carried out, that the writer unhesitatingly recommends it as a preliminary to all surface boring operations on this mine. With this work a petrological examination should be made of the igneous rocks on the surface, a general observation of the outcrops and of their position with regard to the ore-body, showing, unmistakably, that such a study would reveal information concerning their origin and mode of occurrence. This data would be of assistance in matters connected with underground developments.

The above recommendations concerning surface work must not be taken as an indication that the prospecting work already carried out at the mine has not been effectual, and, indeed, it may be noted here that the work performed has been remarkably successful, but simple operations sometimes help big undertakings, and the inexpensive surface examination might be the means of considerably reducing the cost of defining the limits of the ore-body by boring or by shaft sinking.

During the examination of the Great Fitzroy Mines, some attention was given to the occurrence of small quartz veins occurring in the shales away from the main body. Some of the veins have been trenched, and a small vertical one, found by Messrs. Clancy and Tooker, at a place about eight chains to the north-north-east of the North Shaft (*see* Plate 2) has been exposed for some distance in a tunnel driven for about seventy feet, westerly, through dolerite (?) quartzites and shales. In view of the peculiarities of such veins in the rocks in this locality not being understood, the work which has been done possibly has been justified, but the results have proved very unsatisfactory and there is nothing to warrant the continuation of any further prospecting operations.

METALLURGICAL CONSIDERATIONS.

The old system of working consisted in simply crushing the surface stone in a battery and saving the gold on amalgamated plates, the tailings with the fine gold being allowed to go away without any further treatment. This method was profitable at times, but on the whole the expenditure must have been greater than the receipts, and probably as much gold was lost in the tailings as was saved in the battery.

With the finding of small quantities of sulphides in the oxidised ore, a smelting plant was erected, and a Fraser-and-Chalmers 60-70 ton water-jacket furnace was installed, but proper provision was not made for the supply of ore and the necessary flux, and after running for about two weeks, during which a few hundred tons of ore were smelted, operations ceased and the mine closed down.

A further phase, of recent date, consisted in crushing the semi-oxidised ore in rolls and concentrating it in jigs, the product being shipped to smelting works. The raw sulphides are evidently not amenable to water concentration, and a large quantity of the ore which has been dumped on the surface is now ready for some other treatment. Some experiments have been made in precipitating the copper salts present in the water percolating through the tailings, the precipitation being carried out in launders with scrap iron. The results show that all the copper which has been oxidised to the form of sulphate is removed from the water, but the tailings, which contain, according to the assays made by the management, about two per cent. of copper, retain nearly all the copper as carbonate and as sulphide.

It is now proposed to erect smelting works for the treatment of the sulphide ores containing copper and gold. After that will come the consideration of what is to be done with the quartzites, which are barren of copper and are too siliceous for smelting purposes, and which contain, approximately, four dwts. of gold and about one ounce of silver to the ton.

The cost of quarrying the quartzites might be made very low were operations conducted on a large scale, and if the treatment were to be carried on in conjunction with such other works as might be established in the vicinity, the general expense could be so reduced as to warrant some action being taken.

The simple character of the sulphide ore shows that no complex metallurgical treatment will be requred. Zinc Blende and Galena are present in appreciable quantities in the sulphides occurring in the East Shaft, the Windlass Shaft, and in the West Shaft, all of which, however, are considered by the writer to be outside the main ore body. In the sulphides about the North Shaft the quantity of zinc present does not reach more than one per cent., and sometimes it occurs only in traces. Lead occurs in similarly small quantities, and in only one of the bulk analyses given below is it shown to be present to the extent of even one per cent. The percentage of silica is higher than desirable, and the problem in the treatment of the ore is how to eliminate the excess of this substance, whether to treat it in the furnace by adding additional flux or to remove it by some concentration process prior to smelting.

A microscopic examination of slices of the ore from the mine show that much of the silica and sulphide are too closely associated with one another to be amenable to separation by any mechanical operation, but some portion of it might be treated effectually after fine crushing by some such method as the oil concentration process. Practical experiments, however, would be required to solve the problem of separating the gangue from the mineral.

Five average samples of the sulphide ore were taken from the mine for the purpose of determining the percentages of those substances which would enter into metallurgical considerations, the results of which are shown in the following analyses:—

Analyses of Great Fitzroy Sulphide Ores.

Bulk sample from No. 2 (150 ft.) Level, between North Shaft and a point 100 feet along main northern drive:—

Silica (SiO_2)	67·15 per cent.
Iron (Fe)	10·24 ,,
Alumina (Al_2O_3)	3·37 ,,
Lime (CaO_2)	0·70 ,,
Magnesia (MgO)	1·42 ,,
Copper	3·24 ,,
Lead	0·58 ,,
Zinc	0·98 ,,
Sulphur	11·20 ,,
Gold	2 dwt. 5 gr. per ton
Silver	8 dwt. 0 gr. ,,

Bulk sample from along the main northern drive, No. 2 Level, between a point 100 feet north of shaft and the face of the drive at 230 feet :—

Silica (SiO_2)	43·22 per cent.
Iron (Fe)	20·41 ,,
Alumina (Al_2O_3)	3·10 ,,
Lime (CaO)	0·98 ,,
Magnesia (MgO)	1·13 ,,
Copper	3·56 ,,
Lead	0·82 ,,
Zinc	0·78 ,,
Sulphur	22·45 ,,
Gold	2 dwt. 0 gr. per ton
Silver	2 dwt. 14 gr. ,,

Bulk sample from along Eastern and Western Cross-cuts, off the main northern drive, No. 2 Level :—

Silica (SiO_2)	41·87 per cent.
Iron (Fe)	22·06 ,,
Alumina (Al_2O_3)	1·81 ,,
Lime (CaO)	0·84 ,,
Magnesia (MgO)	1·03 ,,
Copper	4·89 ,,
Lead	1·00 ,,
Zinc	0·32 ,,
Sulphur	24·08 ,,
Gold	6 dwt. 14 gr. per ton
Silver	6 dwt. 0 gr. ,,

Bulk sample from all workings in the Intermediate (182 ft.) Level :—

Silica (SiO_2)	61·60 per cent.
Iron (Fe)	11·76 ,,
Alumina (Al_2O_3)	2·76 ,,
Lime (CaO)	0·75 ,,
Magnesia (MgO)	0·53 ,,
Copper	3·21 ,,
Lead	0·48 ,,
Zinc	1·02 ,,
Sulphur	10·48 ,,
Gold	0 dwt. 19 gr. per ton.
Silver	13 dwt. 4 gr. ,,

Bulk sample from all workings in the No. 3 (204 ft.) Level :—

Silica (SiO_2)	69·28 per cent.
Iron (Fe)	8·40 ,,
Alumina (Al_2O_3)	4·78 ,,
Lime (CaO)	0·64 ,,
Magnesia (MgO)	1·18 ,,
Copper	1·73 ,,
Lead	0·34 ,,
Zinc	0·89 ,,
Sulphur	9·28 ,,
Gold	1 dwt. 0 gr. per ton.
Silver	9 dwt. 14 gr. ,,

These results show the ore in the workings around the North Shaft to be very siliceous and comparatively low in iron and sulphur, and that in the ore of the northern workings on No. 2 Level a marked change in the proportion of these substances has taken place.

Something might be added concerning the fluxes required in smelting the sulphide ore. The mine, or its environments, cannot produce any stone which would be of any assistance in fluxing, and it will be necessary to depend upon outside sources. Limestone can be obtained at the Quarry Reserve three miles to the south-south-east of Tungamull Railway Station, where the outcrops show that the quantity available might not be very large, but that the quality is all that could be desired, an analysis of a sample showing that it contains 99·4 per cent. of carbonate of lime, and 0·6 per cent. of silica, iron, magnesia, &c.

The Glenmore limestone deposits, on Portions 116 and 117, in the parish of Murchison, county of Livingstone, is about seven chains from the bank of the Fitzroy River, and close to Limestone Creek, and about four miles from Rockhampton. (*See* Plate 1.) The limestone has been used for many years for making lime, the supply being found to be practically inexhaustible, while the quality is similar to that of the Tungamull limestone. From the mines the limestone quarry is about nineteen miles distant, of which twelve miles is traversed by the railway from North Rockhampton to New Zealand Gully. The three-mile road between the former station and Glenmore is across level country, and the quarry could easily be connected up with the railway by a branch line along the bank of the river.

There are also limestone deposits on several of the islands near the coast, principally on Marble Island, to the north of Keppel Bay, a supply from which would necesitate about 150 miles of water carriage to the railway at Broadmount, and thence 22 miles by rail to Tungamull. On this island there are available unlimited quantities of limestone, of which the following is an analysis:—

Analysis of Marble Island Limestone.

Carbonate of Lime ($CaCO_3$)	97·5 per cent.
Carbonate of Magnesia ($MgCO_3$)	Trace.
Silica and Insoluble	1·88 per cent.
Iron (Fe_2O_3) and Alumina (Al_2O_3)... ...	0·74 ,,
	100·12 ,,

Ironstone occurs in many places in the district around Mount Chalmers, but up to the present it is only found in small quantities, and totally inadequate for smelting purposes. Iron Island, belonging to the same group as Marble Island, will probably be found the most conveniently situated for supplies, and the excellent quality of the iron-

stone there, which is hematite mixed with magnetite, is shown by the following analysis :—

Analysis of Iron Island Ironstone.

Water	0·13 per cent.
Silica	2·51 ,,
Alumina	2·95 ,,
Iron	64·72 ,,
Manganese	...
Lime	2·85 ,,
Magnesia	1·07 ,,
Phosphorous	0·065 ,,
Titania	...

Details of the limestone and ironstone deposits in the Central District are given by Mr. Ball in a report issued by the Geological Survey :—*

The supply of fuel for smelting purposes presents no difficulties whatever. Ipswich and Burrum each produce coke of very good quality for smelting purposes, and some of the Queensland smelting works are being supplied with coke from collieries at these localities.

Analysis of Burrum Coke.

Moisture	0·33 per cent.
Volatile Hydrocarbons...	2·40 ,,
Fixed Carbon	81·95 ,,
Ash	15·32 ,,

Analysis of Ipswich Coke.

	Unwashed.	Washed.
Moisture	0·35 per cent.	... 0·5 per cent.
Volatile Hydrocarbons ...	0·58 ,,	... 0·4 ,,
Fixed Carbon	81·09 ,,	... 85·5 ,,
Ash	17·98 ,,	... 13·6 ,,

Dawson River coal must also be considered as a future rival of the southern cokes as a fuel for blast furnaces, it being semi-anthracitic in composition, changing very little in burning, is very firm and compact (in certain localities), very low in ash, does not cake or coke, and contains a very high percentage of fixed carbon. The mean of several analyses taken from large bulk samples show the coal to have the following composition, the samples being taken from a seam which is six feet six inches thick and unbroken by any bands of dirt or partings :—

Analysis of Dawson River Coal.

Moisture	2·42 per cent.
Volatile Hydrocarbons	11·59 ,,
Fixed Carbon	78·42 ,,
Ash	7·52 ,,

At present the mines are in a state of development, and are not connected with the railway, but surveys have been made of routes to connect with the Mount Morgan Line and to the Central Line at Westwood and at Herbert's Creek. From the mines to Mount Morgan the distance is about seventy miles, to Westwood about sixty miles, and to Herbert's Creek and Boolburra each about forty miles.

* On Certain Iron Ore, Manganese Ore, and Limestone Deposits in the Central and Southern Districts of Queensland.—L. C. Ball. By Authority : Brisbane, 1904, page 66 (G.S.Q., Pub. No. 194).

Coal also occurs near the Bluff and Blackwater Railway Stations on the Central Line, the distance of the former being 107 miles from Rockhampton, the latter 119 miles. The Bluff Colliery is now producing a good steam coal which has the following composition :—

Analysis of Bluff Coal.

Moisture	1·4	per cent.
Volatile Hydrocarbons	8·4	,,
Fixed Carbon	79·4	,,
Ash	10·8	,,

The Mammoth Colliery at Blackwater is idle at the present time, but the fine coal seam which has been worked there is somewhat similar to that at the Bluff in composition, but has a greater tendency to coke when being burnt. The Bluff coal is now being made into coke by an admixture with it of a percentage of tar and crude petroleum, the product being very hard and bright and well suited for smelting purposes. This coke, as manufactured in a small furnace at Rockhampton by Mr. Heskett, has the following composition :—

Analysis of Coke made from Bluff Coal.

Moisture	1·17	per cent.
Fixed Carbon	85·47	,,
Ash	13·36	,,

Clay occurs in the northern workings of the Fitzroy Mine, as the decomposition product of the basic dykes referred to previously. A general sample from a four-foot dyke in the eastern cross-cut at the northern end of No. 2 Level shows the clay to be of inferior composition, as seen from the following analysis :—

Analysis of Clay from the Four-foot Dyke, Eastern Drive, No. 2 Level, Fitzroy Mine.

Loss at 120 degrees C	7·4	per cent.
Silica (SO_2)	33·7	,,
Alumina (Al_2O_3)	15·6	,,
Iron Oxide (Fe_2O_3)	17·9	,,
Lime (CaO)	3·7	,,

NOTE.—The water of hydration, and the magnesia and alkalies present were not estimated, as the proportion of iron present shows the clay to be unsuitable for making fire-bricks. (Government Analyst.)

Chromite, which is being utilised as a refractory material in the lining of furnaces, occurs near Tungamull Railway Station, and an outcrop is now being opened up by Mr. Tooker with a view of supplying the mineral to smelting works. Analyses of two bulk samples as quarried and delivered to smelting works shows that it contains, on an average, about 50 per cent. of chromic acid.

YIELDS.

The returns from the ore smelted in 1899 by the first English company, the "Mount Chalmers Copper Mining Company," show that 432 tons of ore were treated which averaged a little under five per cent. of copper, but it is not known whether this refers to the quantity

of the copper in the ore or the yields from the ore as the result of treatment. The matte produced in the smelting (quantity unknown) contained 34 per cent. of copper, 1 oz. 9 dwt. of gold per ton, and 27 oz. of silver per ton.

The returns from the recent concentration and hand-sorting of the ore by Messrs. Charley and Osborne, show that 1,456 tons of crude ore have been treated since 7th September, 1906, yielding over 200 tons of concentrates and prill ore, for a return of £3,248. The details below show the concentrates to have a value of about £16 per ton, and the original ore, which yielded the concentrates, must have had a value of about £2 per ton, plus the value of the copper, gold, and silver left in the tailings:—

Returns from Concentrates, Etc.

Lot.	Weight.				Copper—per cent.	Gold—per Ton.			Silver—per Ton.			Value.		
	Tons	cwt.	qr.	lb.		Oz.	dwt.	gr.	Oz.	dwt.	gr.	£	s.	d.
Lot 1	86	13	1	17	18·94*	0	1	12	1	13	0	1,382	14	6§
Lot 2	51	9	0	6	18·44*	0	1	21	1	11	0	801	7	6§
Lot 3	40	11	0	24	18·16*	0	2	15	1	10	0	637	16	3§
Lot 4†	9	0	0	0	14·5*	0	3	0	2	2	0	141	12	0
Lot 5‡	12	11	0	4	13·6*	0	2	6	1	10	0	285	0	10
Total Quantity	200	4	2	23		Total Value			...			£3,248	11	1

* From this quantity 1·3 per cent. of copper was deducted before being valued by the smelting works.

† Lot 4 has been concentrated from 57 tons of crude ore, assaying 3·52 per cent. of copper 19 gr. of gold per ton, and 19 dwt. of silver per ton.

‡ Hand dressed ore.

§ Copper taken at £110 per ton, gold at £4 per ounce, and silver at 2s. 8d. per ounce.

Under "Historical Notes" reference is made to the reported yields from the mine prior to 1896, when the Mount Chalmers Copper Mining Company began operations.

HISTORICAL NOTES.

In the year 1860 or thereabouts, a prospector named Hill discovered that gold existed in the ferruginous quartzites close to the base of the ridges that afterwards became known as Mount Chalmers. With a party of men he removed some tons of stone from the more promising outcrops, and this was crushed in an old ten-head battery at Cawarral, a township four miles to the north-north-east of the mine. The stone is stated to have yielded from fourteen to sixteen dwts. of gold to the ton by battery treatment.

In 1860 or 1861 Chalmers took possession of the property and sunk the East Shaft to its present depth, and stoped out all the payable gold-bearing stone which could be conveniently obtained between the surface and the bottom of the shaft. He also took out the stone to the south of what is now the entrance of the Adit Level, and sunk the old inclined shaft situated about seventy-five feet south of the Adit Level, and now covered over with débris. The yields from the stone taken out of these workings are said to have been fourteen dwts. of gold per ton, the stone being crushed at Chalmers's five-head battery at New Zealand Gully, about a mile from the mine.

About the year 1891, a long time after Chalmers worked the mine, a Sydney company (Messrs. Seaver and Scott) started developing the mine, the work consisting chiefly in driving the Adit Level and in opening up the cross-cut known as the "Ballroom." From the latter workings 265 tons of stone were crushed in a ten-head battery erected at the mine by Messrs. Burns and Twigg, of Rockhampton, but the estimated yield of nine dwts. of gold per ton was not realised, and the mine again closed down, after which Messrs. Burns and Twigg, themselves, crushed about 100 tons of ore. The battery after remaining idle for two or three years was removed to Struck Oil, near Mount Morgan, and subsequently to Black Ridge, near Clermont.

Some time afterwards, the date uncertain, Messrs. Murray and a'Court sank a winze to a depth of twenty-nine feet at a position 250 feet in from the mouth of the Adit Level, and the same party also sank a shallow shaft, twenty feet deep, about 480 feet to the southward of the mouth of the Adit Level. The winze afterwards developed into the main shaft, now known as the North Shaft, and the shallow shaft afterwards became the "A" shaft. The work done by Murray and a'Court was purely of a prospecting character, and none of the stone they raised from the mine was crushed in a battery.

Between 1894 and 1896, the Osborne-Charley Syndicate worked the mine, sinking the "A" shaft to a depth of 125 feet and putting up the "rise" in the Seventy-five-foot Level close to the shaft. They also put in a forty-foot drive to the west from the bottom of the East Shaft to connect with the old underlie workings sunk by Chalmers in 1861, and another drive sixty feet to the eastward from the same level.

Between 1896 and 1899 the mine was worked by "The Mount Chalmers Copper Mining Company"—the first English company—with which is associated the name of Bergl, and which spent £17,000 in machinery and in mining development. This company stoped around the "A" Shaft in the "rise" above the drive to the north of the shaft at the 75-foot Level, cut out the chamber in the level west of the shaft, and stoped the country to the north of the shaft. The company also sank the West Shaft, opened the workings in that shaft at 155 feet, erected a water-jacket smelter, and installed two first-class mining and pumping engines and a nest of boilers of the Cornish type. Notwith-

standing all these operations they only smelted 432 tons of five per cent. copper ore. Captain Nicolas was in charge of the mine during this period.

Between the years 1901 and 1903 the Fitzroy Copper Company (an English-Australian company) worked the mine, and continued the West Shaft to 195 feet, its present depth, also putting in the drive at 105 feet, which they proposed extending to "A" shaft. They also drove the long north-westerly drive from "A" shaft.

Between 1904 and 1907 Messrs. Charley and Osborne worked the mine, sinking the North Shaft from the surface to connect with Murray and a'Court's winze below the Adit Level, and continuing it to a depth of 220 feet. They acquired the engines and boilers lying idle at the mine, erected the concentrating plant, extensively prospected the sulphide ore-bodies by driving levels, and brought the mine up to its present excellent condition.

The company now controlling operations is called the "Great Fitzroy Gold and Copper Mines, Limited," having taken possession in May of this year, and with a working capital of £175,000 have started to vigorously develop the property.

Brisbane, July 20th, 1907.

Appendix.

The geological examination of the Great Fitzroy Mine at Mount Chalmers was made at the beginning of May, 1907, and on 30th August advantage was taken of an opportunity which presented itself to make a short visit to the mine for the purpose of inspecting the underground developments which have been carried out since that first examination.

In No. 2 Level, the main north drive has been extended into the country beyond the wall, but only barren rock was encountered. The wall was then followed along its course to the north-east and then to the south-east, the line of demarcation between the country rock and lode being quite distinct. On the eastern wall in this level a lot of work has been performed, including the making of crosscuts, driving along the boundary of the lode, putting up rises, and sinking winzes, the results of which are considered by the management to be most satisfactory. On this level there has been proved, along a line in a north-and-south direction, 350 feet of ore, the southern boundary of

the lode not being known, while, altogether, four winzes have been sunk which have proved ore to exist in a solid body down to sixty-five feet below the No. 2 Level. Some of the ore is sufficiently rich to smelt, while other portions it will be necessary to concentrate.

The western boundary of the lode is of inferior grade, but sufficiently rich for concentration purposes. The ore in Block 1 (*see* Plans) has been proved to be, generally, of inferior quality, and by the management has not been included in their estimate of tonnage and values, although portions are undoubtedly of high grade.

Below No. 2 Level a drive has been opened from the North Shaft, at 180 feet from the surface, to meet another began in "A" Shaft, this work being considered advisable on account of getting good ore in the most southern extension of No. 2 Level, and also to afford better facilities for supplying ore to the smelter.

A diamond drill has recently been working on the mine, and these bores were sunk, one on the eastern side of the lode, the other two at the northern end. The eastern bore indicates that the wall retains its easterly inclination, and that the lode continues to dip in this direction. The other bores, at the northern end, have been sunk to indicate the position of the wall at certain depths, and when that information was obtained and the lode tried for a few feet, operations were discontinued. The parts of the lode bored into showed results which the management consider very satisfactory.

Concerning the quantities of ore available it may now be taken for granted that double the quantity of ore mentioned in the body of this report has been proved since the first inspection was made, and what was then given as an approximate estimate, has now been proved to be an absolute one, thus the tonnage would amount to about 400,000 tons. The values have also improved both in copper and gold, and the increases in the ore recently exposed more than counterbalances the ore in Block 1, which has been classed by the management as being of low grade.

From the time the Great Fitzroy Company started work in May, £10,000 has been spent on the property, of which the underground developments have cost £6,000. Future operations will embrace the blocking out of the ore in No. 2 Level, opening up the new 180-foot level, enlarging North Shaft, making roads, and installing the water-jacket smelter.

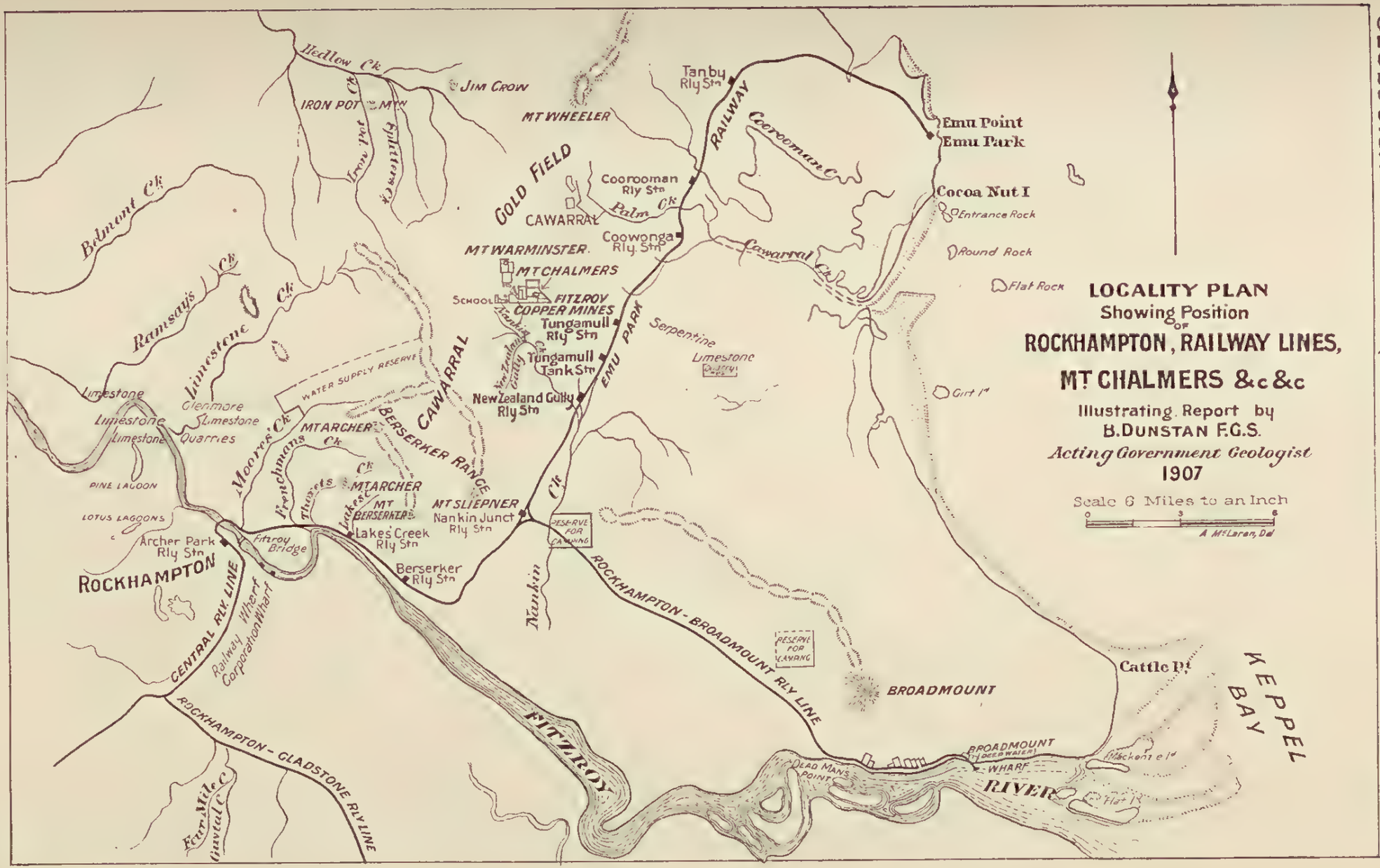
Brisbane, September, 1907.

By Authority: George Arthur Vaughan, Government Printer, Brisbane.

PLATE 1.

Locality Plan, showing Position of Rockhampton, Railway Lines, Mount Chalmers, Etc.

The plan is on a scale of six miles to one inch, and shows the position of the Emu Park, Broadmount, and Gladstone railway lines, the Fitzroy River and the Broadmount Wharf, the stations with which a branch line from the Fitzroy Copper Mine would connect, and the locality where the limestone deposits occur at Tungamull and Glenmore.



GEOLOGICAL SURVEY OF QUEENSLAND

PLATE I

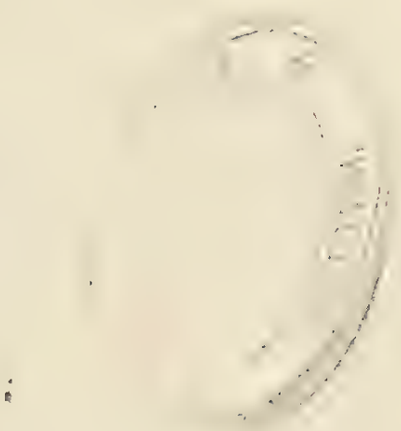
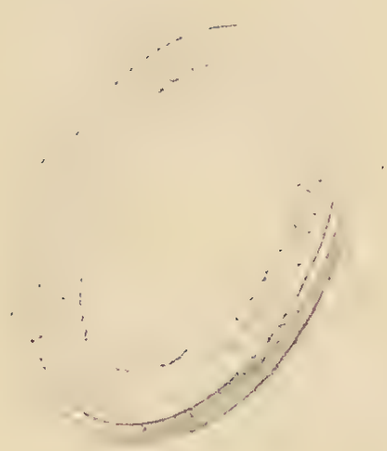


PLATE 2.

PLAN SHOWING TOPOGRAPHICAL FEATURES AT MOUNT CHALMERS.

The features are shown in red contour lines, the heights being obtained by aneroid measurements. Rankine Hill, Charley's Hill, and Osborne Hill are prominent features in the vicinity of the Fitzroy Mine, while Mount Chalmers, to the north, towers above them all. The plan is on a scale of four chains to one inch.



MOUNT CHALMERS

M.L.83 Clancy & Tooker
a 21. r 0 p 13

Clancy's Tunnel

M.L.87 A.S.R.Osborne & P.Charley
a 41. r 1. p 13

RANKINE HILL

M.L. 85 W.Thompson 40 Ac.
includes M.H. 46

M.L. 72 A.S.R.Osborne & P.Charley
40 Ac

M.H. 46 F.Finn 10 Ac.

OSBORNE HILL

Dam (E)

Dolerite

West Shaft 34

North Shaft 86

THE GREAT FITZROY GOLD & COPPER MINES

Windlass Shaft

Dolerite House

Concentrating plant

East Shaft 48

"A" Shaft 41

Engine House

Old Furnace

Reservoir

Manager's Office

Magazine

Flue

Offices

Store

Boiler Chimney

Dolerite

Chimney

Dolerite

M.L. 86 A.S.R.Osborne & P.Charley
a 19. r 3 p 38

TOWNSHIP OF MT CHALMERS
M.H. 51
M.H. 394

M.H. 43

Stoney Ck

ROAD

CHARLEY'S HILL

PLAN
Showing
TOPOGRAPHICAL FEATURES
OF
MOUNT CHALMERS
Illustrating Report on the
GREAT FITZROY GOLD & COPPER MINES
BY
B. DUNSTAN

Note. Contours are based on Aneroid Measurements.
Scale. 4 Chains to an Inch

A. McLaren Del.

PLATE 3.

PLAN OF THE UNDERGROUND WORKINGS OF THE GREAT FITZROY COPPER AND GOLD MINES, MOUNT CHALMERS.

All the developments below the surface are shown on the Plan as well as the position of all the surface workings. Details of the individual levels and of the lines of sections as shown hereon are given on separate plans. The scale of the Plan is eighty feet to one inch.

PLAN
OF
UNDERGROUND WORKINGS
OF THE
GREAT FITZROY COPPER & GOLD MINES
MOUNT CHALMERS
Illustrating Report by
B. DUNSTAN F.G.S.
Acting Government Geologist
1907

Scale 80 Feet to an Inch
80 60 40 20 0 20
A. McLaren Del

GEOLOGICAL SURVEY OF QUEENSLAND

PLATE 3

LINE OF SECTION (See Plate 5)

W. Shaft 193 Ft

Gully

Faults in country & ore

Country ore

V.D. 105 Ft
V.D. 155 Ft

Western Workings

Barium Shales - Quartzites

Barytes & Slates

X CUT AT 60' in Quartzite

Shallow Shaft

No 3 Windlass Shaft V.D. 60 Ft

Barytes, Zinc & Copper in Shales

Red Shaft 8' below No 3 Shaft

Old Workings

Open Cut

Large Quartzite Outcrop

Quartzite

Shaft V.D. 25 Ft

Wall

SYNCLINAL FOLD

Old Workings

LINE OF SECTION (See Last Figure)

Shallow Shaft in Slate & Lode

Old Workings Tunnel

Country Rock

Shaft V.D. 35 Ft

Shaft V.D. 30 Ft

Slate on top Lode below

Clay Shales and Slates

WATERCOURSE

Slate & vein of black Oxide along drive to End Winze 6

Hard Quartzite 8' Rise with Iron Pyrites & Oxide of Copper

Quartzites

RISE

A. Shaft Workings

225 Ft LEVEL (Below No 1 Shaft Collar)

Old Sh covered over

Quartzite with Iron Pyrites

Shaft V.D. 125 Ft

Winze 10

Chamber

Copper taken out

Wall or Fault on Bedding

Quartzites & Slate Interbedded

Traces of Copper 230 Feet from Shaft

Steep Dip

Slates Quartzites & Cherts, with Quartz Veins

Flat Dip

LINE OF SECTION (See Plate 4)

OFFICE

FLUE

STACK

ASSAY OFFICE

STORE

Fence

BOILER CHIMNEY

A

LINE OF SECTION (See Plate 4)

Clay Shales

Wall Ore

Vertical Dyke

Clay Shales

Wall

Clay

Dyke

2 Ft Dyke

Small Dykes

Northern Workings

Wall

No 3

Slate & Quartzite on Surface

204 Ft Level

D

North Shaft

No 3

Intermediate (182 Ft) Level

No 1 (120 Ft) Level

No 1 Winze

Winze 40'

Wall dips 30° at bottom of Winze

No 2 (150 Ft) Level

Adit (45 Ft) Level

The Ballroom

Clay Seam

Clay Seam

Large Quartzite Outcrop

Clay Seam

Hard Quartzite Fragmentary Quartzite

Level

Heads nearly Vertical Clay Seam

Quartzite Outcrop

OPEN CUT

Adit 45 Ft Level

Clay Seam

Clay Seams dip Southwesterly

Ferruginous Quartzite

Copper Stains

Upper Stopes

LADDERWAY

17 Ft above A. Shaft V.D. 50 Ft

E. Shaft

Stoped

Eastern Workings

LINE OF SECTION (See Last Figure)

F

LINE OF SECTION (See Plate 4)

Water Course

B

NOTES

Plan of No 1 Level See Plate 6
Plan of No 2 Level See Plate 7
Plan of Intermediate Level See Plate 8
Plan of No 3 Level See Plate 9

PLATE 4.

Section of Underground Workings on Line A.B, shown on Plate 3, at the Great Fitzroy Copper and Gold Mines, Mount Chalmers.

The section is a north and south one, and shows the position of the North Shaft, the "A" Shaft, the various levels and winzes, and the underground features in the southern and northern ends of the ore deposit. The scale is eighty feet to one inch.

SECTION OF UNDERGROUND WORKINGS ON LINE A-B (PLATE 3)

AT THE

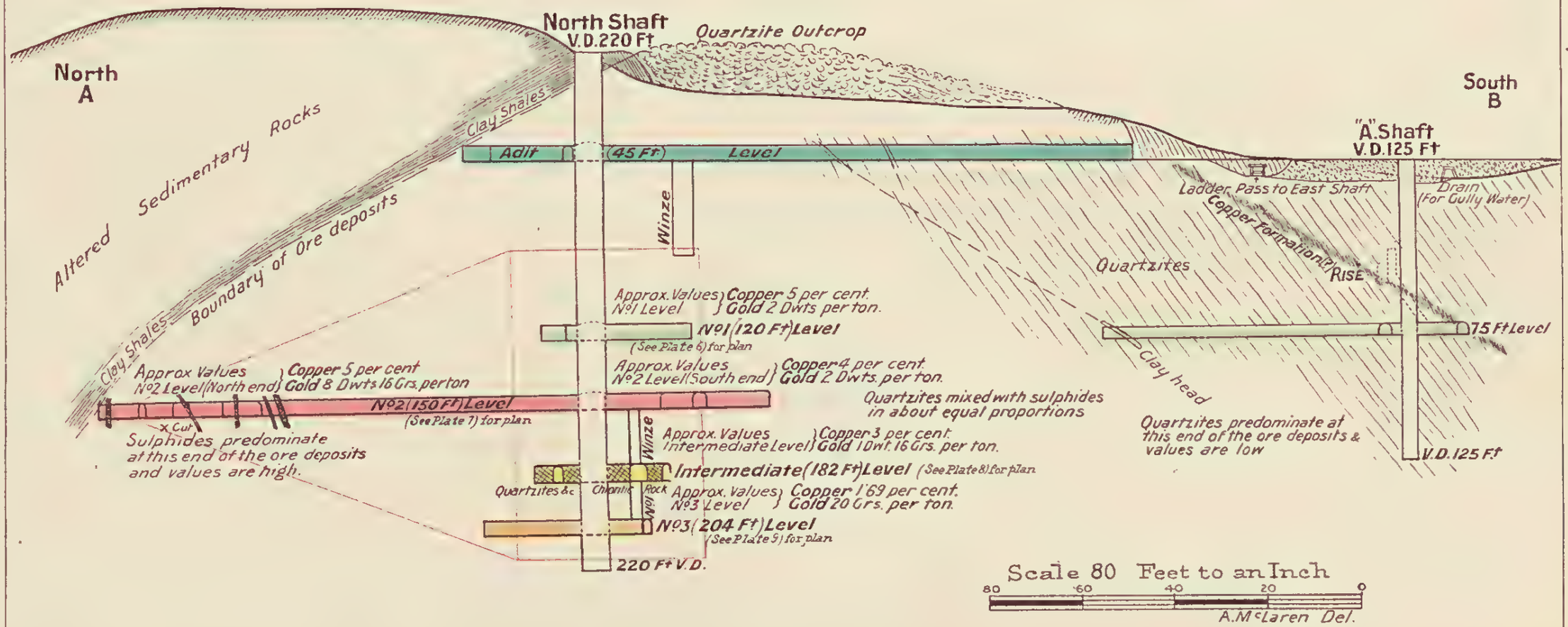
Great Fitzroy Copper-Gold Mines

MOUNT CHALMERS

BY

B. Dunstan F.G.S. Acting Govt Geologist

1907


North Shaft
V.D. 220 Ft.
Quartzite Outcrop
North
A
South
B
"A" Shaft
V.D. 125 Ft
Altered Sedimentary Rocks
Clay Shales
Boundary of Ore deposits
Clay Shales
Adit (45 Ft.) Level
Winze
Ladder Pass to East Shaft
Drain (For Gully Water)
Copper Formation? Rise
Quartzites
Approx. Values No. 1 Level } Copper 5 per cent. Gold 2 Dwts per ton.
No. 1 (120 Ft.) Level
(See Plate 6) for plan
75 Ft Level
Approx Values No. 2 Level (North end) } Copper 5 per cent Gold 8 Dwts 16 Grs. per ton
Approx. Values No. 2 Level (South end) } Copper 4 per cent. Gold 2 Dwts. per ton.
No. 2 (150 Ft.) Level
(See Plate 7) for plan
Quartzites mixed with sulphides in about equal proportions
Clay head
X Cut
Sulphides predominate at this end of the ore deposits and values are high.
Winze
Approx. Values Intermediate Level } Copper 3 per cent. Gold 1 Dwt. 16 Grs. per ton.
Quartzites predominate at this end of the ore deposits & values are low
Intermediate (182 Ft.) Level (See Plate 8) for plan
Quartzites &c
Chloritic Rock
Approx. Values No. 3 Level } Copper 1·69 per cent. Gold 20 Grs. per ton.
No. 3 (204 Ft.) Level
(See Plate 9) for plan
220 Ft V.D.
V.D. 125 Ft

Scale 80 Feet to an Inch

80 60 40 20 0

A. McLaren Del.

GEOLOGICAL SURVEY OF QUEENSLAND

PLATE 4

NATIONAL MUSEUM
VICTORIA.

PLATE 5.

Section of Underground Workings on Line C.D, shown on Plate 3, at the Great Fitzroy Copper and Gold Mines, Mount Chalmers.

The section is taken from east to west, and shows the position of the West Shaft and its underground developments, the North Shaft and all the levels connected with it, and the probable line of junction between the barren country and the ore deposit. The scale is eighty feet to one inch.

SECTION OF UNDERGROUND WORKINGS ON LINE C-D (See PLATE 3)

AT THE

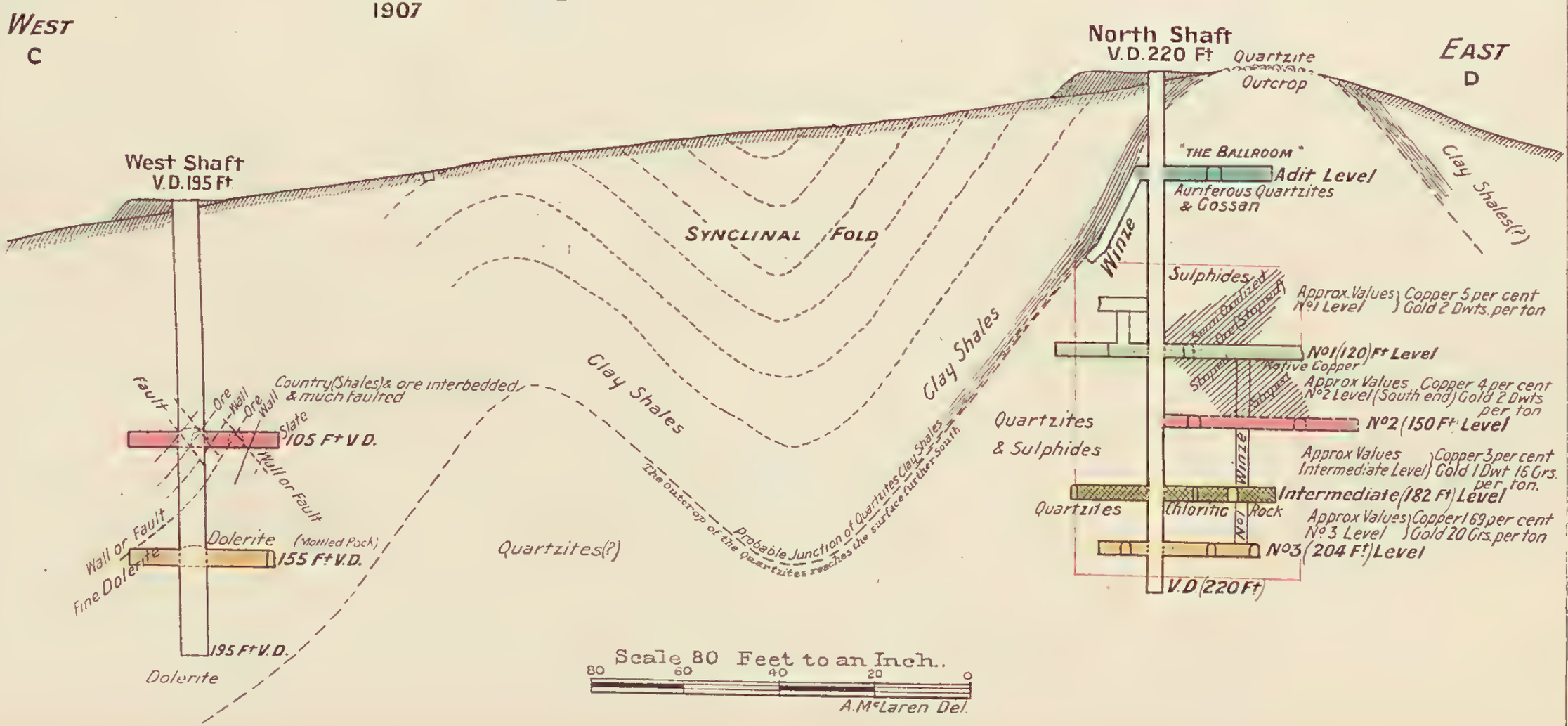
Great Fitzroy Copper-Gold Mines

MOUNT CHALMERS

BY

B. Dunstan, F.G.S. Acting Govt Geologist.

1907



Scale 80 Feet to an Inch.

80 60 40 20 0

A. McLaren Del.

GEOLOGICAL SURVEY OF QUEENSLAND

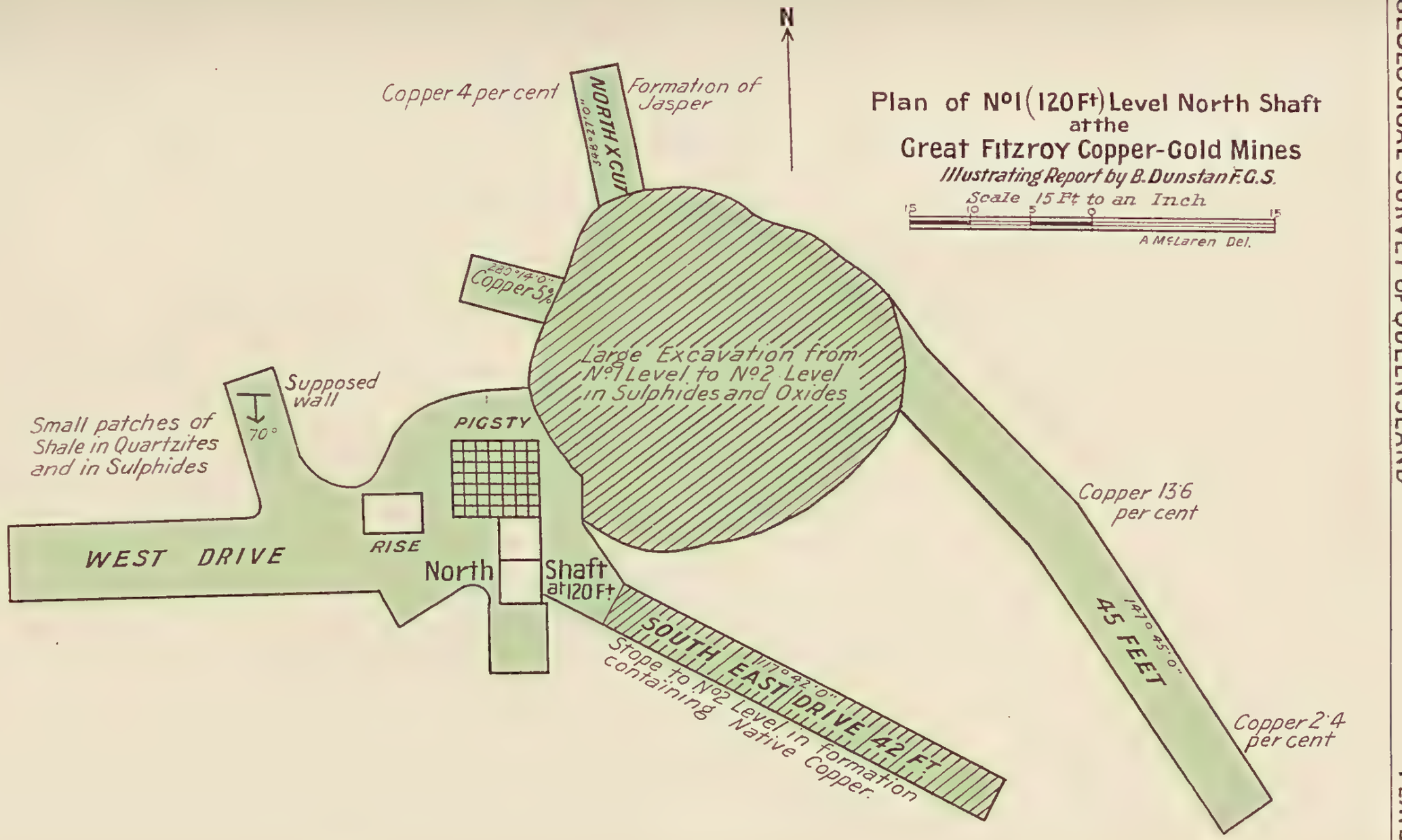
PLATE 5

VICTORIA

PLATE 6.

PLAN OF No. 1 (120 FT.) LEVEL, NORTH SHAFT, AT THE GREAT FITZROY COPPER AND GOLD MINES.

The large excavation shown in the centre extends both above and below this level, and the two cross-cuts to the north-west are the remnants of drives which were cut away as the excavation was extended laterally. The south-east drive reaches to the level below, and is the locality from where the large quantity of native copper was taken out. The scale of the Plan is fifteen feet to one inch.


N
Plan of No1 (120 Ft) Level North Shaft
at the
Great Fitzroy Copper-Gold Mines
Illustrating Report by B. Dunstan F.G.S.
Scale 15 Ft to an Inch
15 10 5 0 15
A McLaren Del.
Copper 4 per cent
NORTH X CUT
Formation of Jasper
220° 14' 0"
Copper 5%
Large Excavation from No1 Level to No2 Level in Sulphides and Oxides
Supposed wall
70°
Small patches of Shale in Quartzites and in Sulphides
PIGSTY
RISE
WEST DRIVE
North Shaft at 120 Ft
SOUTH EAST DRIVE 42 FT.
117° 42' 0"
Stope to No2 Level in formation containing Native Copper
Copper 13·6 per cent
147° 45' 0"
45 FEET
Copper 2·4 per cent

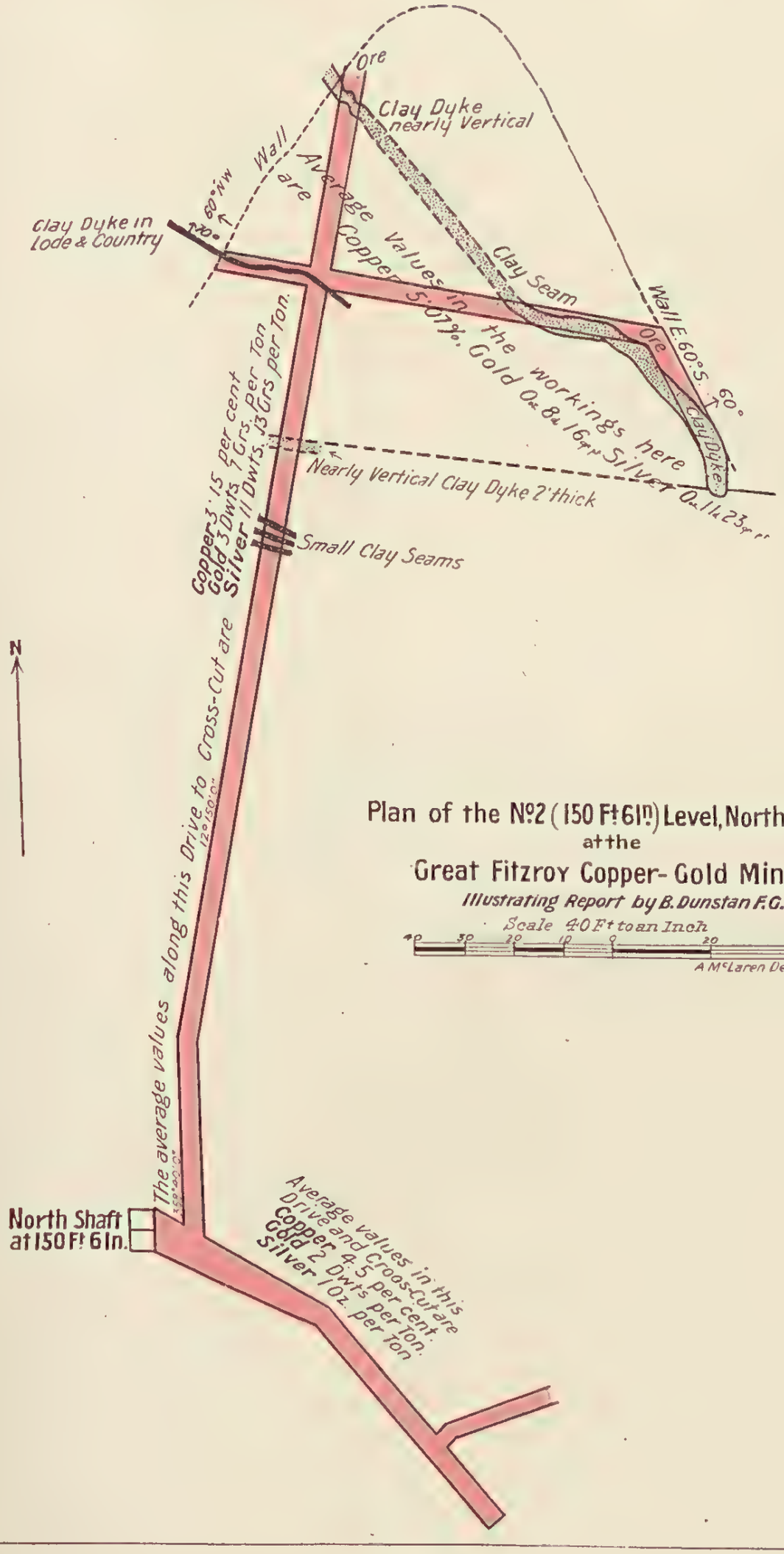
VICTORIA

PLATE 7.

PLAN OF THE No. 2 (150 FT. 6 IN.) LEVEL, NORTH SHAFT, AT THE GREAT FITZROY COPPER AND GOLD MINES, MOUNT CHALMERS.

This is the level in which most of the recent work has been carried out, above and below which developments in future will be undertaken. The boundary wall to the north, which swings around both to the east and west, is unquestionably the limit of the ore deposit in this part of the mine, but a lot of ore might be found to exist immediately below it and towards the south-east, where the eastern boundary wall will probably be found to continue. The clay seams crossing the drives in various directions might prove to be a network of dykes.

The general position of this level is shown in plan on Plate 3, and in sections on Plates 4 and 5. The scale is forty feet to one inch.


Ore
Clay Dyke nearly Vertical
Wall are
60° NW
Clay Dyke in Lode & Country
Average Copper values in the workings here 5·07%. Gold 0z. 8d. 16gr. Silver 0z. 14. 23gr.
Clay Seam
Wall E. 60° S.
60°
Ore
Clay Dyke
Nearly Vertical Clay Dyke 2' thick
Copper 3·15 per cent
Gold 3 Dwts. 7 Grs. per Ton
Silver 11 Dwts. 13 Grs per Ton.
Small Clay Seams
N
The average values along this Drive to Cross-Cut are
North Shaft at 150 Ft 6 In.
Average values in this Drive and Cross-Cut are
Copper 4·5 per cent.
Gold 2 Dwts per Ton.
Silver 10z. per Ton.

Plan of the No2 (150 Ft 6In.) Level, North Shaft at the Great Fitzroy Copper-Gold Mines

Illustrating Report by B. Dunstan F.G.S.

Scale 40 Ft to an Inch

40 30 20 10 0 20 40

A McLaren Del.

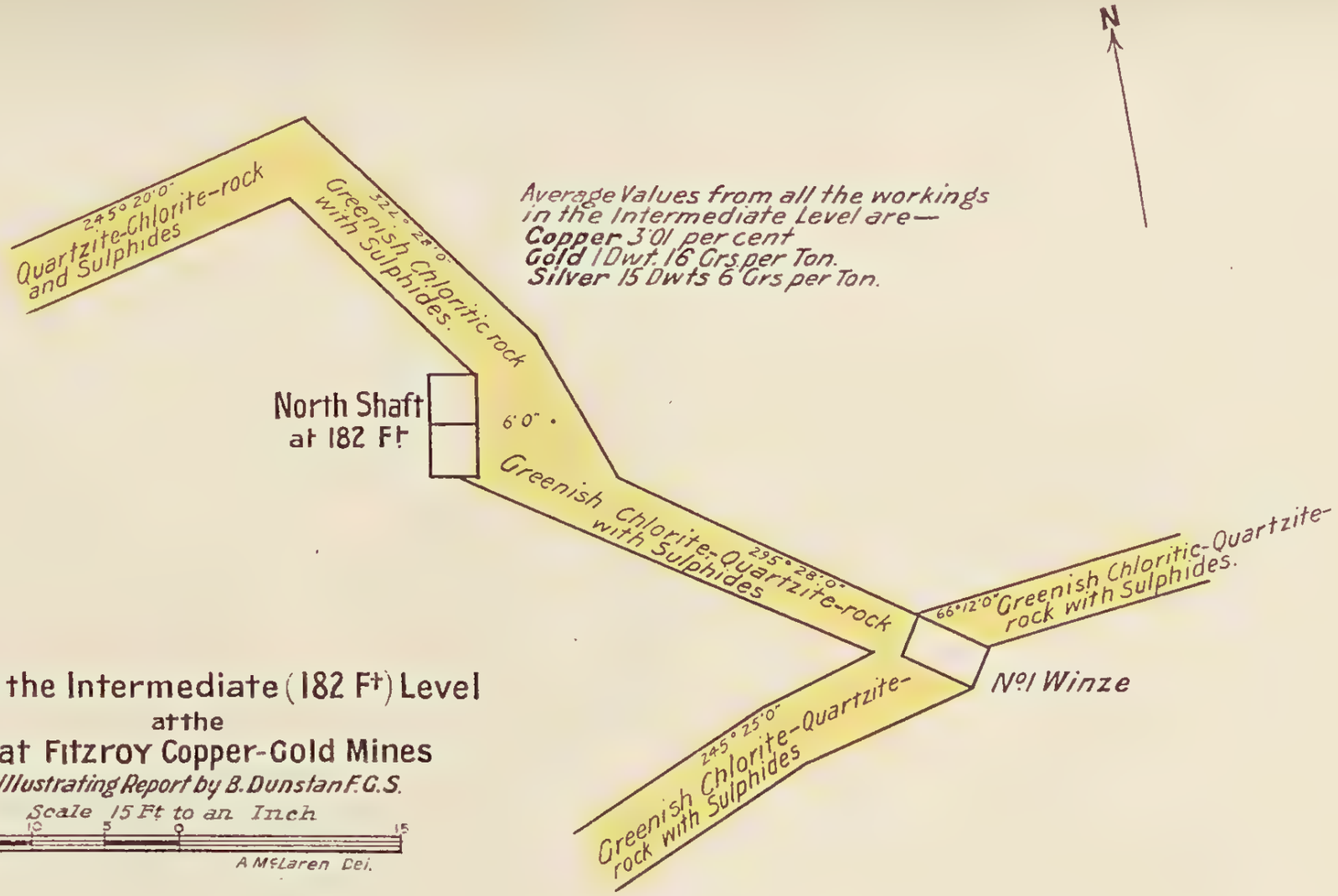
NATIONAL MUSEUM

PLATE 8.

Plan of the Intermediate (182 ft.) Level, North Shaft, at the Great Fitzroy Gold and Copper Mines, Mount Chalmers.

The developments on this level are limited to workings to the south-east and to the north-west, a greenish chloritic rock being a conspicuous rock in the quartzite and sulphide ore-body.

The general position of this level is shown on Plates 3, 4, and 5. The scale is fifteen feet to one inch.



Plan of the Intermediate (182 Ft) Level at the Great Fitzroy Copper-Gold Mines

Illustrating Report by B. Dunstan F.G.S.

Scale 15 Ft to an Inch

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PLATE 9.

PLAN OF No. 3 (204 FT.) LEVEL, NORTH SHAFT, AT THE GREAT FITZROY GOLD AND COPPER MINES, MOUNT CHALMERS.

The general position of this level in the mine is shown on Plates 3, 4, and 5.

The scale is fifteen feet to one inch.

Plan of No3 (204 Ft) Level North Shaft at the Great Fitzroy Copper-Gold Mines

Illustrating Report by B. Dunstan F.G.S.

Scale 15 Ft to an Inch

15 10 5 0 15

A McLaren Del.

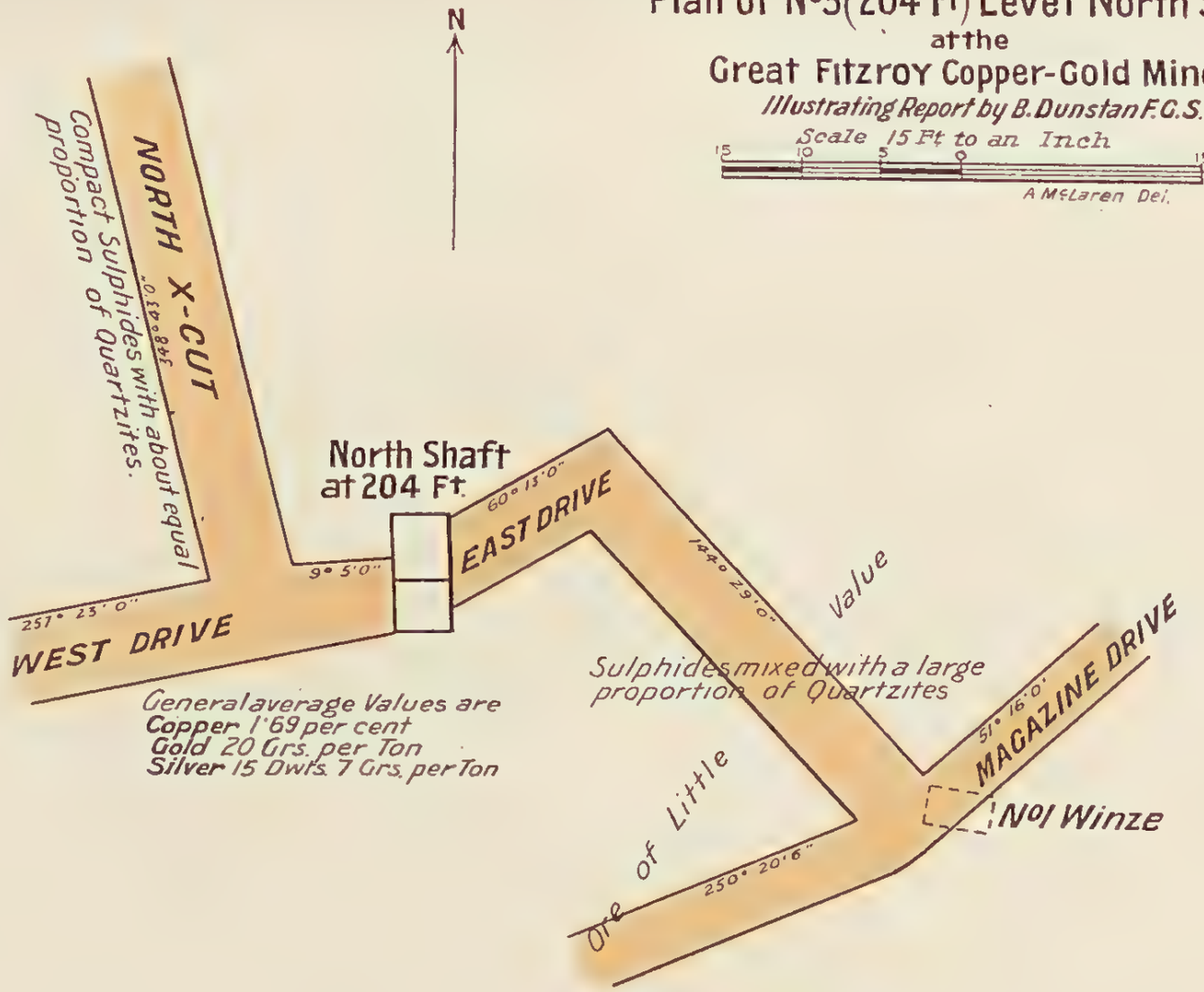

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PLATE 10.

View of the Great Fitzroy Mine from the Manager's Office. Looking North-east.

The engine-house and "A" Shaft are on the right, the No. 1 Old Workings are to the left, partly hidden by trees. The North Shaft is in the background to the left, and the top of Osborne Hill is seen in the background to the right.

Mount Chalmers is in the far distance, to the left.

View of the Great Fitzroy Mine from the Manager's Office. Looking North-East. [*Photo. by B. Dunstan.*

Plate 10.

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PLATE 11.

View of the Great Fitzroy Mine from the "North" Shaft. Looking South.

The heap of stone to the right is all sulphide ore ready for smelting. The tramway from the North Shaft drops about forty feet on a uniform incline to "A" Shaft in the background. The offices are on the hill in the background to the right. Charley's Hill is in the distance.

View of the Great Fitzroy Mine from the "North" Shaft. Looking South. [*Photo. by B. Dunstan.*

Plate 11.

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PLATE 12.

View near Mouth of the Adit Level, Great Fitzroy Mine.
Looking North.

The "Open-cut" extends from the right foreground across the mouth of the Adit Level, then north-westerly under the inclined tramway. The stone from these workings was crushed in a battery many years ago. No 1 Old Workings are to the left, which were also worked many years ago.

View near Mouth of the Adit Level, Great Fitzroy Mine. Looking North. [*Photo. by B. Dunstan.*

Plate 12.

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PLATE 13.

View of the West Shaft, Great Fitzroy Mine. Looking North-east.

At the present time this is being used as a water shaft, the water being pumped to the elevated reservoir near the offices on the side of the hill close to "A" Shaft. The shaft is considered to be away from the main ore-body, being too far west.

View of the West Shaft, Great Fitzroy Mine. Looking North-East. [*Photo. by B. Dunstan.*

Plate 13.

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PLATE 14.

View of the Dam, Great Fitzroy Mines. Looking Westerly.

This small reservoir receives the drainage from the hills around Mount Chalmers, and with the water from the West Shaft has been sufficient for all purposes up to the present time. Further water conservation will probably necessitate a reservoir lower down on Nankine Creek.

View of the Dam, Great Fitzroy Mines. Looking Westerly.

[*Photo. by B. Dunstan.*

Plate 14.

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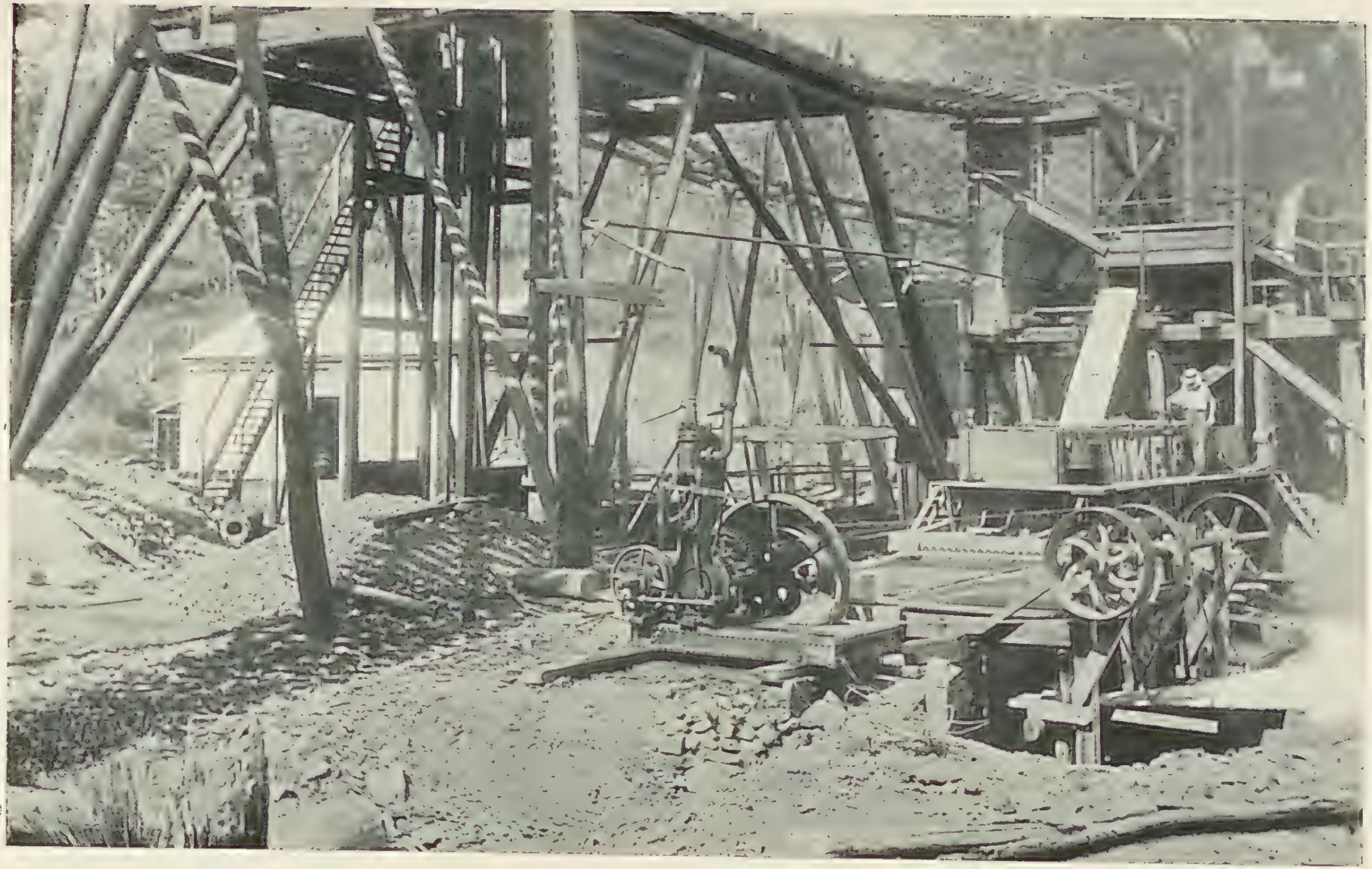
PLATE 15.

VIEW OF THE CRUSHING AND CONCENTRATING PLANT AT THE "A" SHAFT, GREAT FITZROY MINE.

Most of the stone treated by this plant has been taken from No. 1 Level and from the large excavation between that level and the one below, the ore being semi-oxidised and in a form somewhat favourable for water concentration. The proposed innovations will probably necessitate the dismantling of all of this machinery.



View of the Crushing and Concentrating Plant, Great Fitzroy Mine. [*Photo. by B. Dunstan.*

Plate 15.

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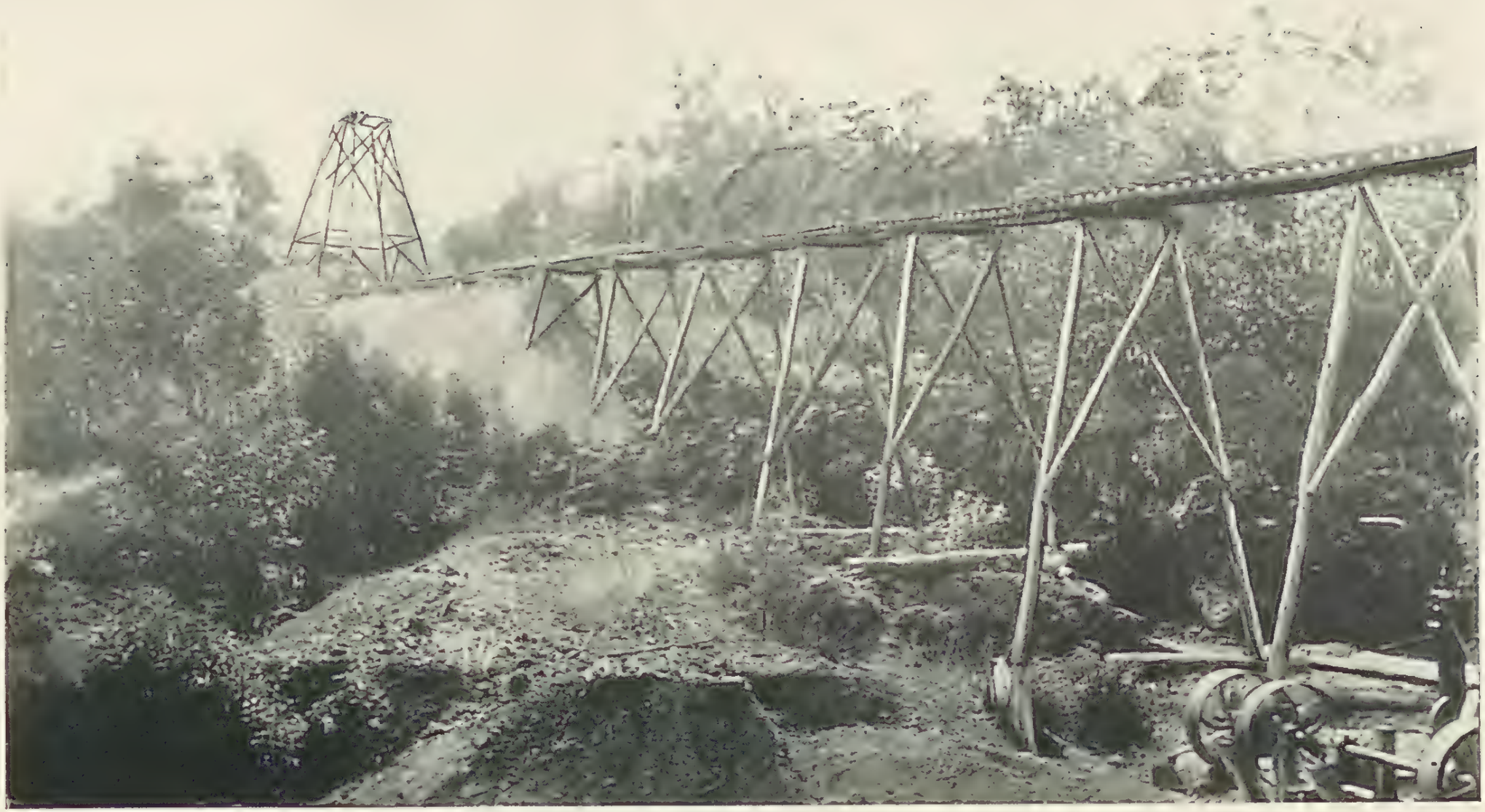
PLATE 16.

VIEW OF TRAMWAY, NORTH SHAFT, AND NO. 1 OLD WORKINGS.

The tramway is inclined from the North Shaft, in the distance, and the No. 1 Old Workings are shown in the foreground on the left side. The Adit Level is on the right and the hill in the background is Osborne Hill.



View of Tramway, North Shaft, and No. 1 Old Workings. [*Photo by B. Dunstan.*

Plate 16.

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Queensland.

DEPARTMENT OF MINES.

Queensland Geological Survey.

(B. Dunstan, Government Geologist.)

PUBLICATION No. 219.

The Etheridge Goldfield.

(SECOND REPORT ON)

WITH MAP AND 7 PLATES.

BY

WALTER E. CAMERON, B.A. (Cantab.).

ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE:

BY AUTHORITY: ANTHONY JAMES CUMMING, GOVERNMENT PRINTER.

1909.

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Sketch Map of Principal Portion of Etheridge Goldfield, at End.

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ST. GEORGE STREET, GEORGETOWN.

CAPITAL OF THE ETHERIDGE GOLDFIELD.

THE ETHERIDGE GOLDFIELD.

I.—INTRODUCTION.

The Etheridge Goldfield occupies an area of over 13,000 square miles of the country drained by the Etheridge, Gilbert, and Einasleigh Rivers, the centre of the field being about 200 miles in a direct line south-west of Cairns, with which port it is being now connected by rail. The bulk of the mining on the field has been for gold, and has been confined to that portion of this large area which lies along the head waters of the Etheridge River and its tributaries, the Delaney River, and Sandy Creek. Of recent years the high prices ruling for the industrial metals has led to a certain amount of prospecting of silver-lead and copper shows, but up to the present the output of these metals has been insignificant. A little stream tin was also worked during 1906.

The reefs about the Etheridge and its tributaries are scattered over an area about 30 miles in length by 20 miles in width. The greater portion of the gold output has been derived from about twenty important reefs that have been worked at one time or another on a considerable scale. A very large proportion, however, is the result of crushings from a great number of reefs which have been worked by means of windlass alone, and have been abandoned as soon as the richer surface stone has been exhausted, and the miner has been faced with the problem of contending with water or of doing heavy unremunerative work in order to develop more stone.

The maximum output of reef gold was recorded in 1893, with a return of 29,185 oz. of gold from 25,807 tons of stone. After that year the yield rapidly declined, till in 1900 it stood at 9,694 oz. from 9,801 tons of stone. Since 1900 the return of reef gold has remained fairly constant, with a yearly average of about 9,000 oz. per annum.

The field was last reported* on by an officer of the Geological Survey in 1900, and the main features of the reefs then working were described. A great portion of the gold-bearing quartz of the Etheridge carries a heavy admixture of sulphides of iron, lead, and zinc, which have prevented the economic treatment of the ore by ordinary battery processes, as they entail long and expensive grinding of the minerals

* The Etheridge and Gilbert Gold Fields. By. W.E.C. G.S.Q. Publication, No. 151.

to obtain what is at best only an imperfect extraction of the gold. The possibility of dealing more satisfactorily with this difficulty by affording cheap rail transit of the heavy sulphide ores and the concentrates from the mills has recently renewed interest in the field. The prospect of obtaining considerable traffic in this material has, among other considerations, led to the construction of the line now being built from Almaden to Charleston, the latter locality being the centre around which the greater bulk of such material is expected to be obtained.

II.—PRESENT CONDITION OF MINING.

During the eight years that have expired since the field was last reported on by the writer, the only mines that have been worked with any degree of system and success have been the International and Jubilee, in the northern portion of the field, and the Havelock, Queenslander, and Nil Desperandum in the neighbourhood of Charleston, about 25 miles to the south.

The International Mine, situated about five miles south of Georgetown, has been opened out by six levels to a depth of 357 ft. and over a length of about 500 ft. At the time of my last visit it was being worked by a number of shallow shafts, extending to a depth of about 100 ft. only. This reef up to the end of 1907 has crushed some 17,180 tons of stone for a yield of 18,672 oz. of gold. The greater portion of this stone has been lightly mineralised and easily treated.

The Jubilee Mine, at Cumberland, has been worked continuously since 1901, the main shaft having been sunk from the 100-ft. to the 280-ft. level, and about 4,908 tons of stone crushed, a return of 2,038 oz. 7 dwt. of gold, having been recovered by amalgamation. In addition, a considerable amount of gold, of which there is no official record, has been won from the cyanidation of the concentrates and sands.

In the group of mines round Charleston the greatest development has been on the Havelock reef. This reef lies fairly flat, and has been followed down the underlie to about 300 ft. from the outcrop. It has crushed during the last four years some 6,151 tons, for a return of 7,952 oz. 17 dwt. The greater portion of this material has been heavy pyritic stone, which has required expensive grinding of the concentrates for only a partial extraction of the gold. On the Queenslander and Nil Desperandum Mines, which were down 280 ft. and 380 ft. respectively at the time of my visit in 1899, no sinking has since been done, but driving at the lower levels has afforded a considerable amount of additional stone. The results for the eight years ending December, 1907, have been—for the Queenslander, 2,664 tons, for 2,122 oz.; and for the Nil Desperandum Mine, 2,110 tons for 2,079 oz.

TOWNSHIP OF CHARLESTON, ETHERIDGE GOLDFIELD.

TERMINUS OF CHILLAGOE-ETHERIDGE RAILWAY, NOW UNDER CONSTRUCTION.

Plate II.

The following table gives the output of the five more or less regularly producing mines mentioned above, for the years 1900 to 1907:—

Mine.	Quartz Crushed. Tons cwt.	Yield of Gold. Oz. dwt.
International	14,621 10	15,063 14
Havelock	7,718 17	9,698 0
Nil Desperandum	2,110 0	2,079 0
Queenslander	2,664 0	2,122 18
Jubilee	4,506 0	1,870 16
	32,620 7	30,834 8

It will thus be seen that only two of the mines on the field have been characterised by any considerable output during the last eight years, and it is patent that the life of the field can be expected to be prolonged only by some distinct reduction in the costs and improvement in the method of mining and treatment, or in the opening up of some yet undiscovered sources of wealth.

The total output of reef gold from the field for the same period is given in the following table:—

OUTPUT OF REEF GOLD FROM ETHERIDGE FIELD, 1900-1908.

Year.	Quartz Crushed. Tons cwt.	Yield of Gold. Oz. dwt.
1900	9,801 0	9,693 17
1901	8,087 10	9,042 9
1902	6,776 1	6,682 11
1903	10,430 18	10,229 2
1904	8,746 2	8,735 8
1905	8,315 19	8,346 13
1906	10,547 7	9,788 6
1907	10,575 0	8,828 7
Total	73,279 7	71,346 13

The list of reefs from which crushings are recorded varies yearly from 50 to 100, while the number of which there is any record runs into nearly 200. It will thus be seen that quite one-half of the gold yield of the Etheridge is still obtained from numerous small crushings obtained from a number of reefs scattered over a wide area, and worked in a spasmodic and unsystematic manner.

The cause of the depression of the last ten years on the Etheridge Field has no doubt to be sought for in the exhaustion of the bulk of the easily mined and easily treated shallow stone, but is no doubt to some extent accounted for by the difficulties experienced in dealing with the refractory ores met with below the water level. A contributing cause has also apparently been a noticeable reduction in the gold values of many of the reefs as the deeper levels were reached. This reduction in values, though not so pronounced as to warrant abandonment of further opening up of the lower levels in view of the greater facilities for economical mining offered by the railway nearing

completion, has frequently been sufficiently marked to discourage small parties of men struggling against adverse conditions, and hampered by want of capital for proper development and economical working of their mines.

III.—GEOLOGY.

1. The Rock Formations.

The general geological features of the Etheridge rock formations were described in a former report by the author,* and the recent examination, having relation more especially to the mining development of late years, was not sufficiently detailed to add much of interest to those observations. The district offers, however, a wide and almost virgin field for the study of an interesting series of altered sedimentary and intrusive igneous rocks, and their relations to the occurrence of the numerous mineral veins.

The altered sedimentary beds can be best studied along the western margin of the field, their junction with the intrusive rocks running from the southern boundary of the field, near Gilberton, in a northerly direction to near Georgetown, where a tongue of the granite, projecting into them from the west, cuts them off from another area of similar beds about Lane's Creek and the northern portion of the field.

These beds have an almost universal E. and W. strike, and generally high alternating dips. The coarser beds of the series—consisting of massive white quartzites, and representing probably the basal beds of the series—occur in an east and west belt, about eight miles in width, in the bend of the Robertson River. Traced to the north and south they give place to schists and slates, with which are associated numerous mineral veins carrying gold, silver-lead, and copper. At Ortona, on the Percy River, in the south of the field, and Mosquito Creek, near Charleston, the slates and schists are intruded by numerous dykes of diorite, with which the mineral veins appear to be intimately associated.

The granite country occupies the greater portion of the rest of the field, except where it has been displaced by the more recent quartz-porphyries, or where denudation has not proceeded quite far enough to remove the whole thickness of the metamorphic rocks into which it has been intruded. The boundaries between the granite and the metamorphic rocks are irregular, and have not been determined with any attempt at precision. The granite varies considerably in character, but has a prevailing porphyritic character, the porphyritic mineral being of orthoclase felspar, and the crystals being generally present with a regular orientation parallel to a banding of the biotite-bearing

* *Loc. cit.*

ground mass, which appears to have been the result of pressure before the magma had completely consolidated. This banding of the granite and orientation of the felspar phenocrysts (which latter are often as much as 2 in. in length) takes, as a rule, an east and west course (*i.e.*, parallel with the direction of strike of the metamorphic beds), and may possibly have been caused by the same strains which brought about that strike. The most important of the mineral veins occur in the granite country.

The porphyry occurs as a belt some 50 miles in length in a N. and S. direction, and some 20 miles in width at the widest point. Owing to its capacity for resisting weathering agencies, this belt of rocks has not been denuded at as fast a rate as the softer granites and metamorphic beds, and has thus been left as a rampart of ranges dividing the Einasleigh waters from those of the Etheridge and Gilbert. This range, though only standing at a height of about 1,000 ft. above the general level of the country, rises so abruptly from the granite on either side as to greatly hinder communication between the most important portions of the field and the eastern coast. It has caused some difficulties in the surveying of a suitable route for the railway line now under construction from Almaden, though these have now been satisfactorily overcome.

In many places the porphyry stands up at its edge in a wall several hundred feet in height above the granite, into which it sends apophyses that betray its later age.

Several reefs of gold-bearing quartz have been found in the porphyry of the ranges, but they have all been small, and have generally been abandoned after giving a few crushings of rich stone.

2. The Gold-quartz Reefs.

The gold-bearing quartz veins occur mainly in the granite formation, though there are numerous examples of their occurrence in the metamorphic beds and in the porphyry. The reefs have a prevailing east and west strike and northerly dip, generally at high angles. This regularity of strike and dip, however, is broken in the northern portion of the field, where the beds take on a more north-easterly to northerly strike.

The reefs occur along simple and comparatively regular fissures, with generally well-defined walls. In a number of cases the walls show evidence of horizontal movement of the hanging-wall and footwall rocks. The regularity of the reefs in strike when followed along any of the levels, and their comparative irregularity in dip, seem to me to point to the same conclusion. In a few cases the vein material appears to be the result of replacement of the crushed and broken

rock, torn from the walls as the result of the movement. The wedging out of the different "makes" of stone, and their replacement by fresh "makes" of a different character, incline one to the opinion, however, that much of the quartz has been deposited in open fissures, as it opened from time to time and gave access to the mineral-bearing solutions.

The vein materials vary from almost pure white quartz to nearly pure masses of galena, zincblende, or iron pyrites, while every variety of association of all these minerals is found. A considerable amount of copper pyrites is also present in some of the reefs.

The precious metals are associated more particularly with the minerals, galena, and pyrites, the highly zinciferous ores being generally discarded as too poor to pay for treatment. As a general rule the freer the stone is from galena and pyrites the lower are its contents in gold and silver.

The weathered stone lying within the zone of oxidation, from the surface to water-level, and enriched in gold contents by the decomposition of the metallic sulphides and the carrying away by meteoric waters of the soluble products of their decomposition, has long been practically all treated from the larger reefs. A considerable proportion of the reef returns, however, is still made up of small crushings of "brown stone" from the numerous smaller reefs scattered over this wide area. This "brown stone," from the ease with which the gold could be amalgamated, gave handsome returns to the early pioneers, and it was not till the "mundic stone," or heavily mineralised stone, was struck about the water-level that the difficulties of the field began.

The heavily mineralised belt met with at the water-level has been found to extend down to varying depths, not only in the different reefs but also in different portions of the same reef. It appears, however, in all those reefs that have been opened to any depth to have given place to much less mineralised stone at depths of from 100 ft. to 300 ft. In the International Mine all the heavy galena ore occurred above the 112-ft. level in the main shaft, the lower limit of this ore descending from there to about the 180-ft. level in the No. 1 East International shaft, situated about 720 ft. further east. In the Durham Mine, four miles west of Georgetown, the heavily mineralised and richly gold-bearing stone, which made the mine famous during the years 1888 to 1890, does not appear to have extended much below the 280-ft. level. In the stoping recently done from the new vertical shaft between the 450-ft. and 350-ft. levels only lightly mineralised stone has been struck, the average tenor of which in gold contents has been about 13 dwt. per ton. The average of the heavily mineralised stone recorded for the years 1888 to 1890 was over 2 oz. per ton for 7,816 tons. In the southern portion of the field the replacement in depth

of the heavily mineralised stone by more siliceous material is not, perhaps, so noticeable, but in the Queenslander Mine there is evidence that the reef is getting less mineralised below the 180-ft. level. In the Nil Desperandum Mines, also, heavy galena-bearing ores, which were met with between the 180-ft. and 280-ft. levels, give place to lightly mineralised stone below, so that here also there are not wanting indications that the heaviest deposition of mineral does not reach to any great depth below the water-level.

The mines mentioned are the only four, now open for inspection, that have been sunk below the 300-ft. level, but there seems every likelihood that in several other reefs not now being worked the same conditions have been found to exist.

This phenomenon is probably to be explained by the theory of deposition of the minerals of the reef from ascending heated alkaline solutions. Owing to the greater solubility of the metallic sulphides in such solutions, as compared with that of silica, it is natural to suppose that the latter will be carried to higher levels in the fissure before precipitation. The less soluble silica will be deposited in greater quantities with the first lowering of temperature and pressure.

This feature of the Etheridge reefs is not a very promising augury for the permanency of the traffic in concentrates expected for the Etheridge line. There are, of course, at present in sight in the various mines that have been opened out to any extent, considerable quantities of heavily mineralised stone, which will keep the line supplied with this class of freight for some time, and there seems every likelihood that the stimulus given to mining generally by the advent of the railway will lead to the development of numerous other reefs capable of supplying mineral traffic to the railway. In the absence of any evidence of a continuance of these heavily mineralised ores with depth, and with the experience of several of the better developed mines as a guide, it seems advisable that the continuance of a supply of these heavy sulphide ores should be proved by extensive development before any very great hopes are built on the possibilities of their occurrence in large quantities.

As noticed before, there has been a fairly general experience that the richer portions of the reefs are those which carry the greater proportion of the metallic sulphides, especially galena and pyrites. The often sudden decrease in these minerals on passing certain levels has thus in many cases been accompanied by a lessening of gold values in the reef, which has been sufficiently marked to lead to a suspension of mining operations and the abandonment of the mine. In several cases, however, and notably in that of the International Mine at Donnyville, the lightly mineralised stone has been extensively worked in the lower levels, and has given thousands of tons of easily treated material, averaging over an ounce of gold to the ton.

IV.—TREATMENT.

With the majority of the reefs heavily mineralised stone was struck at a depth of from 40 ft. to 60 ft. The difficulties experienced in treating this material led to the introduction of elaborate grinding machinery, in which the concentrates were ground with mercury, and the gold more intimately associated with them was thus freed to some extent and amalgamated. This process, however, besides being expensive, gave a very unsatisfactory extraction, and some method more adapted to the treatment of this refractory material has long been a desideratum on the field. Within the last few years some slight improvement has been made in the treatment by the introduction of Wilfley and Card concentrating tables, and by the postponement of any attempt at amalgamation till the bulk of the gold has been concentrated into a small quantity of the heavier sulphides at the head of these tables. These headings are then amalgamated in Berdan pans, and the middlings and tailings stacked for subsequent treatment. This process has been adopted at the Havelock Mill, at Charleston, crushing stone from the Havelock, Queenslander, and Nil Desperandum Mines, and was suggested by the success of the method at the New Ravenswood Company's Mabel Mill at Ravenswood, treating ores of very much the same character. In the case of the Charleston ores, however, as far as I could learn from the values given as being left in the residues from the Berdan pans and in the seconds from the tables, the percentage of extraction by amalgamation has not been nearly as high as in the case of the Ravenswood ores. A considerable amount of gold still remains to be recovered from these seconds and tailings, which are at present being stacked awaiting the completion of the railway to allow of their being despatched to smelters.

At the Donnyville Mill, treating stone from the International Mine, the recent introduction of a Card concentrator has allowed of the treatment during 1907 of a considerable quantity of heavy galena-bearing ore, from which has been obtained 69 tons of firsts, carrying 60 per cent. lead, with 4 oz. of gold and 14 oz. of silver per ton. The bulk of the stone from the International Mine has, however, been amenable to ordinary battery amalgamation, so that the question of economical treatment has never to any great extent hampered the development of this mine.

At the Cumberland Mill, which has during the last seven years been treating ore raised mainly from the Jubilee Mine, the ore, after crushing, is first concentrated on Wilfley tables and the coarse gold recovered from the concentrates by amalgamation in Berdan pans. Apparently about one-half of the total extraction is thus recovered, and the remaining half by cyanidation of the residues from the Berdan pans and the tailings, to which process the ore from this mine is perfectly amenable, owing to its low contents in copper and zinc compounds.

INTERNATIONAL GOLD MINE, NEAR GEORGETOWN.

BRACE AND ENGINE HOUSE OF MAIN UNDERLIE SHAFT.

V.—GOLD MINES.

The International Mine.

The reef found in this mine has been worked to a depth of 357 ft. over a length of about 500 ft., and the main shaft has been recently sunk on the reef to a depth of 433 ft. The reef strikes east and west in granite country, and dips steeply but irregularly to the north. The walls are well defined, and show marked signs of horizontal movement, giving evidence that the reef has been the result of the filling of a fissure brought about by differential movements of the hanging-wall and foot-wall country in an east and west direction. The defined character of the walls and the irregularity of the vertical cross section of the workings show that there could have been little, if any, vertical movement of the walls on one another. Judging from the amount of stone that has been crushed from these workings, the size of the crushing stuff must have averaged between 1 ft. 6 in. and 2 ft., but in many places the reef has been as much as 5 ft. in width.

Previous to 1899 the reef had been worked from numerous shallow shafts scattered over a length of about 900 ft. along the outcrop, and working mostly oxidised ore to about the 60-ft. level, where the heavy sulphide ores came in. These workings gave, according to the record, about 2,779 tons of stone for a return of 2,866 oz. 2 dwt. of gold, previous to 1899. Since that time the central portion of this line of reef has been developed by the main shaft mentioned above, six levels having been driven at depths of 60 ft., 112 ft., 164 ft., 233 ft., 297 ft., and 357 ft. respectively, the shortest continuous level on the reef being 400 ft. in length. From the 60-ft. to the 112-ft. level in the shaft heavily mineralised stone was met with, but was replaced below the latter level by comparatively lightly mineralised stone, which was carried down to the bottom of the present workings. Most of the stone above the 233-ft. level has already been stoped out and crushed, but there is still a considerable quantity standing in the stopes above the two lower levels in the main shaft. About 700 ft. east of this shaft a second shaft has been sunk, on apparently the same reef, to a depth of about 300 ft. At 180 ft. and 232 ft. levels have been put in west along the reef for distances of about 110 ft., and a considerable block of stone between the two taken out. At this point heavy galena stone was met with in the upper level, this character of stone evidently continuing down to greater depths at this point of the reef. As there was no work going on at this shaft, the workings here could not be inspected.

The International Mine up to the end of 1907 had produced 16,915 tons of stone, from which 17,964 oz. of gold had been extracted.

The Durham Mine.

This mine lies about five miles due west of Georgetown, on the Croydon road. During the four years from 1888 to 1891 it is recorded as having given 14,543 oz. of gold from 7,816 tons of stone, but after that date its output declined rapidly, and in 1897 the Warden's annual report states the mine was practically deserted. The mine was worked from two shafts, situated about 700 ft. from each other along the line. The North-eastern (or No. 2) shaft was vertical, and cut the reef (which at this end dipped more flatly than at the south-western end) at a depth of 180 ft. Levels were put in at 182 ft. and 280 ft. to meet those coming from the south-western shaft, where the bulk of the work was being done; but, judging by the plans of the mine now extant, very little stoping was carried out near this shaft.

The bulk of the work was done from the south-western (or No. 1) shaft, which followed the underlie of the reef to beyond the 342-ft. level, and from which the bulk of the stone down to that level, and for a length of about 400 ft. towards the No. 2 shaft, was stoped out. At this point the reef was cut off by a fault, which can be now seen in the 260-ft. level and the three levels below it. This fault shifts the course of the lode some 6 ft. to 10 ft., and up to the present very little stone of value appears to have been met with to the N.E. of it.

The reef was worked by a winze (known as Neil's winze) for about 60 ft. below the 342-ft. level, this winze being about 300 ft. west of the No. 1 shaft, the length of driving from the bottom of the winze having been about 200 ft. This work was done in 1894 and 1895, since which time the mine has been practically abandoned.

During 1907 a new vertical shaft was sunk away from the reef, on the hanging-wall side, between the two old shafts, and at a distance of about 300 ft. from the No. 1 shaft, and a crosscut, put in to the N.W., met the reef, in about 70 ft., at a depth of some 64 ft. below the old workings, and about 450 ft. from the surface. Levels have been driven east and west along the reef struck in this crosscut, and a connection made with Neil's level above. A considerable amount of stoping has been done from these two levels, but, so far, with somewhat disappointing results. The reef exposed in these levels is white in character and low in gold values. About 100 ft. N.E. of the crosscut it is cut off by the crosscourse which was met with in the upper levels, and which throws the reef about 10 ft. or 12 ft. to the S.E. on the N.E. side. Heavy water was met with in the bottom level along this crosscourse, and the levels have not been extended in this direction. At the old No. 2 level (280 ft.) an old winze (about 10 ft. N.E. of the crosscourse) has been cleaned out, and good stone found along the bottom about 50 ft. down. This good material may continue down to the lower levels on the N.E. side of the crosscourse, but otherwise

THE DURHAM GOLD MINE, NEAR GEORGETOWN.

NEW VERTICAL SHAFT.

Plate IV.

the developments have been disappointing. Up to the end of last year 738 tons of stone from the two lowest levels had been crushed, for a return of 501 oz. 4 dwt. of gold.

The Durham Reef occurs in a fissure in granite, showing, as a rule, well-defined but somewhat irregular walls, the reef varying considerably in thickness from point to point, but averaging probably from a foot to eighteen inches.

The heavily mineralised and rich stone worked in the upper levels does not appear to have been found below about the 300-ft. level, where it gave place to the lightly mineralised stone which was disclosed by the recent reopening of the mine, and the average gold contents of which have been under 15 dwt. per ton. The results of this reopening of the mines have proved somewhat disappointing, but the directors have added considerably to the efficiency of the equipment, and are in hopes of making a success of the venture.

The Jubilee Mine, Cumberland.

The Jubilee Reef lies about 2½ miles N.W. of Cumberland Township. It strikes nearly north and south in granite country, and dips steeply to the east. A few yards east of the reef there comes to the surface a large boss of porphyry, from which tongues of the same rock have been sent off into the surrounding granite. No less than three of these tongues of porphyry, from five to thirty feet in thickness, have been passed through in sinking the main shaft, and can be traced through the stopes from the fact that the reef fissure is much narrower in the porphyry than in the granite, and, as a rule, contains no quartz, or only a thin seam. The intrusion of the granite by the porphyry was evidently antecedent to the formation of the reef fissure, which can be traced right through both granite and porphyry bars. These porphyry bars were struck at depths of 80 ft., 200 ft., and 280 ft. respectively in the main shaft, and the plan of the workings show them dipping to the north, in parallel fashion, at an angle of, roughly, 35 degrees from the horizontal.

The quartz of the reef appears to be a replacement of the granite walls along either side of the fissure. Where the fissure crosses the bars of porphyry, however, no such replacement of the walls has taken place, owing, probably, to the more compact and more finely-grained nature of the rock not allowing of the permeation and alteration by siliceous mineral-bearing solutions which has occurred where the walls of the fissure have been of granite.

The reef varies considerably in thickness, in places pinching out entirely and again making to 9 ft. in width, with horses of granite,

which have not been replaced by quartz. Down to the 280-ft. level the reef had yielded up to the end of 1907 about 4,764 tons of stone, for a return of 2,947 oz. of amalgamated gold. The recorded returns from the mine date from 1887. From 1896 to 1901 the mine was deserted, most of the stone above the 100-ft. level having been worked out previous to that date. Since 1901 the material from the mine has been treated by concentrating the crushed stone on Wilfley tables and amalgamating the concentrates in Berdan pans. The tailings are cyanided, and account for a large percentage of the total recovery; so that the reported returns from the battery treatment are no indication of the value of the stone.

The intrusion of the porphyry bars, besides rendering a considerable quantity of the ground barren, has added greatly to the expense and uncertainty of the mining operations, which have also been somewhat hampered by a bad hanging-wall to the reef. The suitability of the ore, however, for amalgamation and cyanide treatment has allowed of a better percentage of extraction of the gold than is possible with most of the Etheridge reefs.

The Havelock Mine.

The Havelock is a flat reef, lying about five miles south of Charleston, on the Castleton road. It strikes east and west, and dips at an angle of about 33° to the north. The reef has been worked for a length of about 400 ft. along the outcrop, but is now being operated from a vertical shaft, 90 ft. in depth (which meets the reef about 180 ft. from the outcrop), and an incline going down about 140 ft. below the bottom of the straight shaft. To the west of the vertical shaft the reef splits into a hanging-wall and footwall vein, and has only been driven on a few feet at 40 ft. and 110 ft. respectively below the bottom of the straight. Very little stone has been taken out on this side of the shaft. The levels at the above depths have, however, been driven 270 ft. and 155 ft. respectively towards the east, and a large amount of stoping has been done in the sulphide ores on this side of the shaft. From the upper level (40 ft. below the straight) the reef has all been stoped out for 260 ft. up to the old workings 70 ft. above, the end of the drive showing about 4 ft. of reef. From the lower level the stone has been stoped up for about 110 ft. in, and the end of the drive shows about 3 ft. of reef. In the end of the stope between the two levels the reef is 7 ft. in width. From these workings to the east of the underlie about 6,150 tons of stone have been stoped since the beginning of 1904, for a return of 7,951 oz. of gold. Till the end of 1907 the total quantity of gold won down to about 300 ft. from the outcrop has been 11,568 oz. 12 dwt. 17 gr. from about 10,095 tons of stone.

Plate V.

HAVELOCK GOLD MINE,. CHARLESTON.

HORSE GEAR ON VERTICAL SHAFT.

Plate VI.

QUEENSLANDER GOLD MINE, CHARLESTON.

MAIN UNDERLIE SHAFT.

The sulphide mineral of the Havelock Reef down to the present bottom of the mine consists mainly of iron pyrites. This ore gives only a very imperfect extraction with the processes employed at the Havelock Mill, the gold being so intimately associated with the pyrites as to be amalgamable only with the greatest difficulty. The residues and seconds from this reef are accordingly reported to be very rich, though I was unable to get any figures as to the values they contain.

The Queenslander Mine.

This mine is situated about two miles due west of the Nil Desperandum Mine, on a reef dipping steeply to the north. The main workings extend for about 540 ft. along the reef down to the 180-ft. level, practically all the stone from this block having been worked out. The shaft is down to a level at 280 ft., from which level a block of ground was stoped for about 250 ft. east of the shaft when the mine was closed down in 1903. Up to that time the main workings had given about 13,115 tons of stone, of an average value of about £4 per ton. This indicates an average thickness of reef of about 17 inches.

The mine was reopened in 1904. The bottom level (280 ft.), which was in 120 ft., had been stopped in poor stone, but a few feet of driving obtained good material again, and the level has since been taken in to 420 ft., and the stone stoped up for about 20 ft., showing a reef averaging about 2 ft. in width, from which about 500 tons of stone have been crushed since 1904, for a return of about 16 dwt. per ton.

In the drive to the east at the 280-ft. level the reef, about 20 ft. from the shaft, split up into thin veins, which were followed in a drive for about 400 ft. A new make of quartz was struck about 200 ft. in, and was followed to the face, where it is about 2 ft. 6 in. in width. The value of this stone is estimated to be about 10 dwt. per ton. At the end (*i.e.*, 400 ft. from the shaft), this level is connected by a winze with the 180-ft. level above.

The 180-ft. level has been lately continued in past this winze. It passed through poor stone beyond the old stopes, 140 ft. in., to the 350-ft. point, where heavy galena ore was struck, and followed to nearly the 600-ft. level, showing a shoot of about 250 ft. of this class of stone, the face still showing 2 ft. 6 in. to 3 ft. of heavy galena ore. This ore has been stoped up to about 40 ft., the top of the stope being connected with the surface through the No. 1 West shaft, about 460 ft. west of the main working shaft. This shoot of stone has not as yet been met with in the No. 3 (280-ft.) level, which requires driving to

prospect it at a depth. It seems likely that a considerable quantity of galena ore will be obtained from this shoot of stone as soon as the advent of the railway allows of its being economically treated.

The Nil Desperandum Mine.

The reef in this mine strikes about east and west in granite country, underlying steeply to the north. The main shoot of ore has been worked for about 500 ft. of its length down to the 380-ft. level by means of an incline shaft near the western end. The continuation of the outcrop can be traced for another 800 ft. east of the main shoot by the position of several shallow shafts, all now abandoned. From Boy's shaft, situated 340 ft. east of the main shaft, a considerable quantity of ground has been worked out to the 160-ft. level, but it is now inaccessible. In the main workings the reef varies very rapidly in thickness, bulging in places to as much as 6 ft. in width, and in others pinching to a thin seam of an inch or two. The average width of the reef over the 500 ft. of shoot worked out to the 380-ft. level has been about 9 in., as far as can be judged by the amount of stone that has come out of the mine. The average recovered value of this stone has been about £4 12s. per ton. Most of this stone was obtained from above the 280-ft. level before the year 1900, when the mine was closed down and allowed to become full of water, the sink from the 280 to the 380 ft. level having proved disappointing. In 1904 the mine was reopened, and the reef driven on at the 380-ft. level for a length of about 230 ft. About 2,078 tons of stone have been obtained since 1905 from above this level and from the ground left standing above the 280-ft. level, but the quality of the material has not been as good as formerly, having averaged under £3 per ton.

A great deal of the stone in this mine is heavily mineralised with galena, much of it being sufficiently heavy and valuable to allow of its being forwarded direct to the smelters.

VI.—SILVER-LEAD MINES.

Mosquito Creek Silver-Lead Lodes.

At the heads of Mosquito Creek a number of galena lodes have been taken up within the last two years, and a few tons of rich silver-bearing galena ore have been despatched by team to Croydon for Southern smelters. According to the Warden's report for 1907, some 96 tons of ore were sent away during the year, and gave returns averaging 61 per cent. of lead and 67 oz. of silver to the ton, thus showing over an ounce of silver to the unit of lead. The bulk of this ore came from the Orion Lease.

NIL DESPERANDUM GOLD MINE, CHARLESTON.

Plate VII.

Up to the present no large bodies of ore have been discovered, and development work has been confined to a few shallow shafts on the most promising of the outcrops. The deepest shaft is on the Orion Lease, 100 ft. in depth, further sinking having been delayed till the advent of the railway and the consequent cheapening of mining costs.

At the time of my visit very little was being done on any of the lodes, for the same reason.

Geology.—The country about Mosquito Creek consists of slates, quartzites, and schists, striking generally east and west, and dipping steeply to the north. The veins of galena occur for the most part along the bedding planes of the slates, but here and there break across them at acute angles, and run along what are apparently joint planes. The diorites occur as bars, running for the most part with the bedding of the slates, and show a certain degree of schistosity in an east and west direction, as if they had been subjected to the same pressures which tilted up the slates while still in a plastic condition.

Several of the lodes in this district were worked to a small extent some years ago, the positions of those of the Orion and Southern Cross being shown on a map of the field made by T. R. Geraghty in 1889. The remains of a primitive shaft furnace, and of a reverberatory furnace made of slabs of slate, are still to be seen on the banks of Mosquito Creek. The following is an account of the recent work on these lodes:—

On the *Orion Lease* a shaft has been sunk, following the dip of the lode, to a level at 73 ft. The level was put in east for 30 ft., and the ore overhead stoped out to the surface. Westward the level followed good ore to about 21 ft., thus proving, with the eastern level and the length of the shaft (9 ft.), a shoot of ore about 60 ft. in length. The ore has all been stoped out along this length to the 73-ft. level. Water was standing in the shaft below the level, but a vein of galena, about 15 in. in thickness, is visible on the hanging-wall of the lode, just below the level in the shaft. The total depth of the shaft is given as 100 ft. At the time of my visit the western level was being driven to meet a winze from the surface, about 66 ft. west of the shaft, and was in about 46 ft. The face showed about 3 ft. of slaty formation, carrying a little gossan, and lying between well-defined walls showing signs of movement. There was a thin vein of galena, about ¼-inch in thickness, on the hanging-wall of the formation. This lease is reported to have given about 200 tons of galena ore, averaging 70 per cent. of lead and an ounce of silver to each unit of lead.

On the *Commonwealth* lode a shaft has been sunk on a narrow vein of galena, striking east and west with the slates, and dipping

steeply to the north, to a depth of 37 ft. The galena is accompanied by a little ferruginous gossany material in places, but generally occurs as a fairly pure seam along the bedding plane of the slates, running up to 6 inches in thickness. There had been despatched from this shaft 5 tons 12 cwt. 3 qr. of ore, for a return of 350 oz. of silver and 3 tons 14 cwt. 1 qr. 8 lb. of lead. Another 20 tons of seconds, estimated to carry 20% of lead and 20 oz. of silver, were stacked on the surface.

On the *Commonwealth Extended No. 1 West* Lode two shafts have been sunk, about 90 ft. apart, and lying E.N.E. and W.S.W. of each other, the westernmost being 20 ft. and the easternmost 12 ft. deep, and the strike of the slates here being N.W. and S.E., so that the vein apparently lies in a fissure cutting across the strike of the slates. About 10 tons of galena had been obtained from these two shafts, the vein making to about 6 inches in places.

The *Southern Cross* lode crops out in the bed of Sawpit Creek, about 20 chains north of the Commonwealth line, and runs parallel to it in an easterly direction. Old workings, now fallen in, are seen about a chain away from the eastern side of the creek, and a shaft has been recently sunk on a gossany outcrop about a chain further east along the line, but without meeting with anything of value. About 10 tons of galena ore are reported to have been obtained by trenching on the outcrop in the bed of the creek.

The *Argent King* line is situated about a mile north of the Orion. A shaft has been sunk here about 60 ft. to the water-level in graphite slates on a thin vein of galena striking with the slates. Three tons 7 cwt. 1 qr. 8 lb. of galena are reported to have been obtained from the sinking, and to have given a return of 1 ton 13 cwt. of lead and 45 oz. 6 dwt. of silver. Drives have been put in a few feet to east and west, but no ore was visible in them.

The *Pleiades* line of lode lies about three miles west-by-north of the Orion, near the junction of Argent King Creek with Mosquito Creek. On lease 71 a shaft has been sunk to a depth of 60 ft., on a gossany formation carrying a little galena, lying between fairly well defined walls of slate from 3 ft. to 5 ft. apart. The gossan can be traced here and there on the surface into lease 69, where a strong quartz and gossan outcrop, some three or four feet in width and carrying galena through it, stands out on the bank of a gully which cuts across the strike of the lode.

The *Crow's Nest* lode is about 2½ miles N.N.E. of the Orion. It was originally worked as a gold show by means of an inclined shaft, about 80 ft. in depth, sunk on the eastern face of a hill overlooking the main head of Mosquito Creek. The shaft afterwards fell in, but

the present owners, on commencing to clean out the shaft, found a seam of galena ore, up to 6 in. in thickness, between the hanging-wall and the quartz reef formerly worked. At the time of my visit they were still putting the shaft in order and erecting a whip to deal with the mullock. A few bags of high-grade galena ore had already been obtained from the old stopes.

Besides the above-mentioned lodes, a few others of less importance have been prospected in a desultory way, but without any important results. With the advent of railway communication it is probable that a fair quantity of rich galena ore will be shipped to the smelters at Chillagoe, and there is some prospect that a few of the lodes will open out as they are sunk on into important lodes of ore.

At present the high costs of carriage to the head of the rail at Croydon (in some cases as much as £9 per ton) have delayed energetic prospecting and development of any of the lodes. The following figures, taken from Warden Hishon's Report for 1907, show the amount and value of the silver-lead ore despatched from the lodes mentioned for that year:—

—	Ore Treated.	Silver.	Value.	Lead.	Value.
	Tons cwt. qr. lb.	Oz. dwt.	£ s. d.	Tons cwt. qr. lb.	£ s.
Orion Mine	87 0 0 0	6,027 0	678 0 9	60 11 0 13	1,074 1
Commonwealth Mine	5 12 3 0	350 0	39 7 6	3 14 1 8	64 1
Argent King Mine ...	3 7 1 8	45 6	5 12 0	1 13 0 0	29 1
	96 0 0 8	6,422 6	723 0 3	65 18 1 21	1,167 3

VII.—COPPER MINES.

1. The Ortona Copper Mines.

These mines lie along the southern bank of the Percy River, about five miles above its junction with the Gilbert. Six lodes have been exploited to the water-level by means of shafts and levels, while in one case sinking, by means of an engine and bailing tank, has been carried down below the water-level.

The country consists of diorites intruding slates, the lodes occurring above the water-level as gossany carbonates and tile ore associated with quartz, and the wall rocks of the lodes being mainly diorite. The diorite shows a marked schistosity in a N.E. and S.W. direction, which corresponds with the bedding of the slates, the lodes running parallel to each other and to this direction.

The lodes were found about the year 1899 by two prospectors—Scarden and Smythe—who got out a few tons of ore and then disposed of the mine to the present owner (John Moffatt and Co.). Since 1899

about 145 tons of rich glance and carbonate ores have been despatched to smelters, and have returned from 30 to 40 per cent. of copper and 3 to 6 oz. silver per ton. In addition, the following amounts and values of ore, according to the estimates of the manager, were stacked at the mine ready for treatment as soon as the reverberatory furnace should be completed:—

I.—Bagging Ore.

No. 1 Lode	15	tons	carrying	25	%	copper	and	60	oz.	silver per ton
No. 2 Lode	40	,,	,,	32	%	,,		6	,,	,, ,,
No. 6 Lode	5	,,	,,	33·5	%	,,		6	,,	,, ,,
	60	,,								

II.—Firsts.

No. 1 Lode	150	tons	carrying	15	%	copper	65 oz.	5 dwt.
No. 2 Lode	350	,,	,,	16·57	%	,,	6 ,,	10 ,,
No. 3 Lode	150	,,	,,	12·60	%	,,	7 ,,	10 ,,
No. 5 Lode	165	,,	,,	10·80	%	,,	1 ,,	12 ,,
No. 6 Lode	850	,,	,,	15·60	%	,,	3 ,,	18 ,,
No. 2 West Lode	200	,,	,,	11·80	%	,,	4 ,,	0 ,,
	1,865	,,						

III.—Seconds.

No. 1 Lode	200	tons	carrying	6	%	copper	30 oz. silver per ton
No. 2 Lode	220	,,	,,	3	%	,,	
	420	,,					

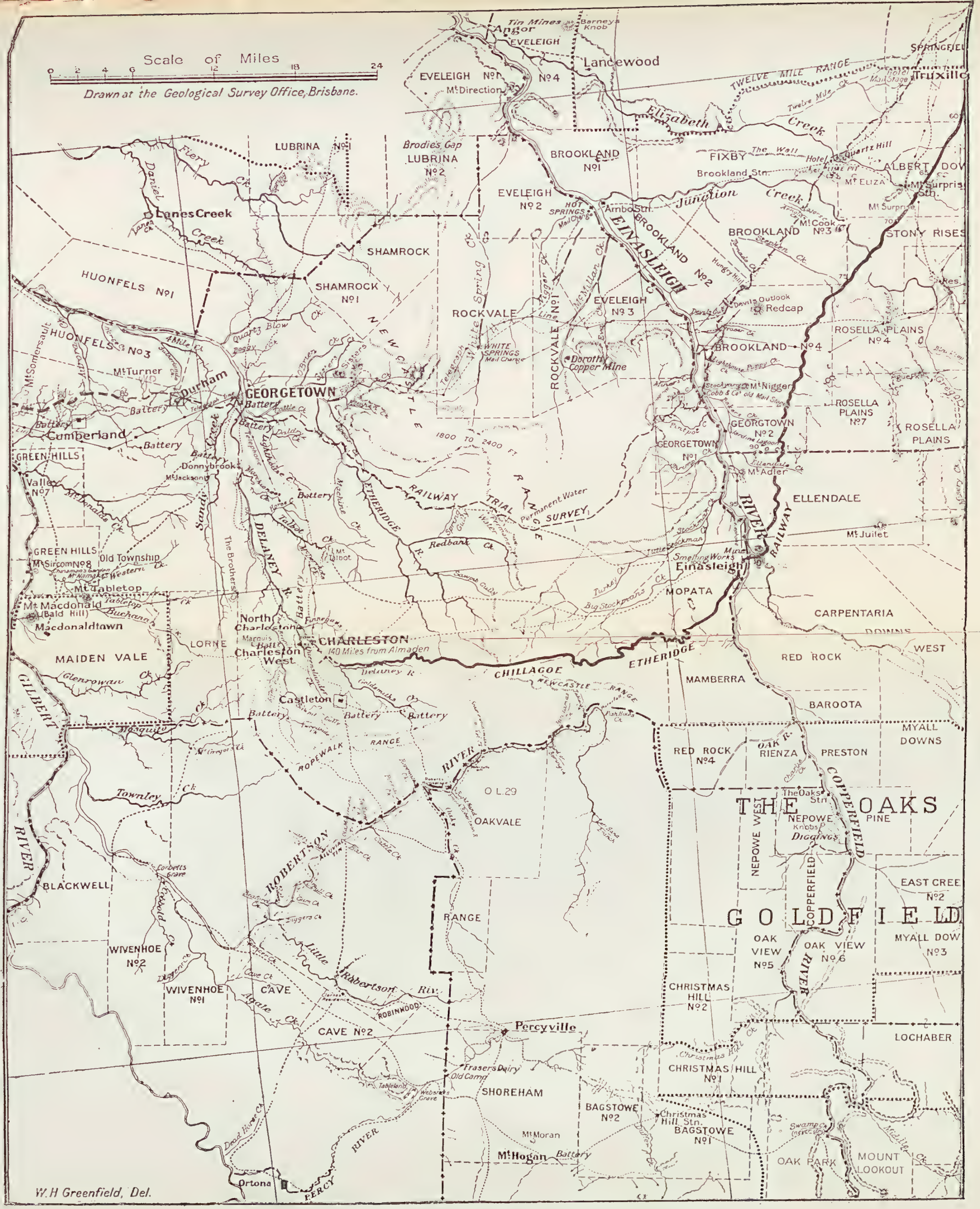
On the *No. 1 Lode* the main shaft has been sunk a depth of 120 ft., and levels driven N.E. and S.W. at the 50 ft. and 100 ft. levels respectively. The workings were full of water below the 50-ft. level. The 50-ft. level had been driven N.E. 133 ft., and connected with the surface by a monkey shaft at 120 ft. in. To the S.W. the level had been driven a distance of 255 ft., and connected with the surface at 155 ft. in. The 100-ft. level had been driven 31 ft. to the N.E. and 48 ft. to the S.W. The average width of the lode has been about 1 ft. in thickness.

On the *No. 2 Lode* a shaft has been sunk to a depth of 165 ft., dipping steeply to the N.W., and levels driven at 65 ft., below which there was water in the shaft. The N.E. level had been driven 85 ft., and the western level 100 ft. The lode has averaged about 2 ft. 6 in. in thickness.

On the *No. 3 Lode* a shaft has been sunk to 60 ft., and levels driven 59 ft. S.W. and 55 ft. N.E., the lode having averaged about 2 ft. in thickness.

On the *No. 4 Lode* a shallow cutting showed about 18 inches of carbonate ore, but no work of much consequence had been done on it.

On the *No. 5 Lode* a shaft had been sunk a depth of 70 ft. in oxidised ores, and levels driven 10 ft. N.E. and 35 ft. S.W., the lode having averaged about 3 ft. in thickness.



SKETCH MAP OF PRINCIPAL PORTION OF ETHERIDGE GOLDFIELD.

VICTORIA

On the *No. 6 Lode* a shaft has been sunk a depth of 150 ft., and levels driven N.E. and S.W. at 104 ft. The N.E. level had been driven 36 ft. To the S.W. the lode split in two a hanging-wall and footwall portion, the former being followed for 140 ft., and the latter for 106 ft. Ninety-five tons of bagging ore, averaging 33·5 per cent. of copper and 6 oz. of silver per ton, have been shipped from this mine, and, as shown by the above table, a considerable tonnage of good smelting ores lie stacked at the mine.

On the *No. 2 West Lode* a shaft has been sunk to the 130-ft. level, and drives put in for 41 ft. east and 70 ft. west. About 200 tons of ore, of the value shown in the above table, had been obtained from this work, and from a bit of open-cutting on the lode, about 60 ft. in length and 18 ft. deep, to the west of the shaft.

It would be impossible to form any opinion of value as to the possibilities of these mines without a much more detailed examination than I was able to give them. Judging by the results of assays reported by the manager, however, they would seem to offer good prospects of turning out successfully if the difficulties caused by their isolated position do not prove too great a handicap for them.

2. The Einasleigh Copper Mine.

Although a very large sum of money has been spent on this mine, it is still in the prospecting stage. About 3,000 tons of oxidised ores are estimated to have been taken from the open-cut on the outcrops upon the bank of the Einasleigh River. About 861 tons of this are reported to have been smelted for a return of 12·9% copper and 2 oz. silver and 3 dwt. of gold per ton, but smelting proved impossible, owing to the difficulties and expense of obtaining coke and fluxes. A main shaft has now been sunk to the 204-ft. level, and crosscuts put in to meet the lode at the 170 ft. and 204 ft. At the 204-ft. level a considerable width of greywackes, impregnated with copper pyrites, was met at two points, distant some 60 ft. apart, but I was unable to learn what were the values of the lode at these points. The mine is now being systematically developed in the sulphide zone, and is expected to furnish traffic to the railway line for many years.

Brisbane, June, 1908.

By Authority: Anthony James Cumming, Government Printer, Brisbane.

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DEPARTMENT OF MINES.

Geological Survey of Queensland.

(B. DUNSTAN, GOVERNMENT GEOLOGIST.)

PUBLICATION NO. 222.

CERTAIN MINES AND MINERAL FIELDS IN NORTH QUEENSLAND.

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A Geological Reconnaissance of Part of the Mesozoic Coalfield, Cook District.
With one Map and two Figures.

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With three Figures.

A Geological Sketch Map of Part of the Annan River Tinfield.

By LIONEL C. BALL, B.E.,
ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE:
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1910.

A GEOLOGICAL RECONNAISSANCE OF PART OF THE MESOZOIC COALFIELD, COOK DISTRICT.

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GEOLOGICAL SKETCH MAP OF PART OF THE COOKTOWN COALFIELD

to accompany report by

LIONEL C. BALL B.E.

Assistant Govt Geologist.

1909

Scale of Miles

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- B — Post-Tertiary basalt.
- C — Cretaceous sediments.
- ω — Trias-Jura coal measures.
- P.C — Permo-Carboniferous coal measures.
- Q — Altered Sedimentaries of undetermined age.
- G — Granite.

A GEOLOGICAL RECONNAISSANCE OF PART OF THE MESOZOIC COALFIELD, COOK DISTRICT.

GENERAL.

Just before the close of the year 1908 a rapid reconnaissance survey was made* of that portion of the Cooktown Coalfield lying between the Normanby and Laura Rivers south of the railway line.

Purpose: The survey was carried out for the purpose of indicating the most favourable spots in which to bore for coal, the people of the district having subscribed £600 for that purpose, and having a promise of a like amount from the Government. This money was collected, it may be mentioned, during a "boom" caused by the reported discovery of a 2-ft. seam of coal, which proved when examined by me to be only 9 in. thick.

Extent: The area under consideration comprises more than 1,000 square miles, the distance from the Brothers on the east to the Laura on the west being 36 miles, and that from Butcher's Hill head station on the south to Battle Camp head station on the north being 38 miles; of this, two-thirds may be taken as covered more or less by coal measures. It is to be remembered, however, that similar strata extend indefinitely to the south-west of the Laura, and to the north of the railway.

Recommendations.

While inclining to the opinion that thick seams are not likely to be found in this district, the evidence is of so inconclusive a nature that I feel disinclined to absolutely condemn any project for boring. After carefully considering the matter, I have come to the conclusion that one of the first places to bore should be in the vicinity of Christie's crop, on the Deighton. It appears likely, however, that the slate basement will be met within 200 ft. (assuming that the slope found to exist between the Normanby and False Crown Hill, shown on Fig. 2, remains unchanged to the west), but by boring from the Brumby Razorback, about a mile to the north-north-west, there should be at least 400 ft. of coal measure to be pierced.

* Mr. Macdonald, the newly appointed assistant, accompanied me on some of the traverses, as did the Messrs. Christie (prospectors) and four other representatives of the Cooktown Coal Prospecting Association.

A much more convenient site for a bore would be at the Deighton Railway Station. A certain thickness of the overlying cretaceous sediments would have first to be pierced, but the basement is probably nearly 1,000 ft. beneath the surface here, and it is just possible that the seams may have improved both in quality and thickness, in the distance of 12 miles from the crop.

Topography.

"Mesas," or tablelands, are among the most prominent and interesting features of the coastal plain inland from Cooktown, for their former connection over practically the whole of this country is evident, and their present isolation indicative of the mature age of the rivers draining the plain. They rise abruptly for as much as 1,000 ft. above the plain, and the upper 200 or 300 ft. is formed of flat-bedded sandstones presenting mural faces on all sides; and the areas of the plateaux vary from a few acres to many square miles.

The greater part of the coalfield examined is occupied by a much dissected plateau, and, though mesas (such as Coal Mountain) are not wanting, it is more particularly characterised by cañons, which are indicative of the comparative youth of the streams, and point to elevation of the central area having taken place in quite recent times. The section (Fig. 2) from the Deighton railway station to the Normanby River brings out this arching well, and shows how the cañons west of the Normanby River have as yet been able only to just reach the basement of the coal measures.

Westwards of a line drawn from Sandown to the Laura coal crops is a peneplain covered in great part by deposits of Cretaceous and later age.

As a result of traverses made in the northern part of the field, considerable additions have been made to our knowledge of its topographic features, and it is to be regretted that a traverse was not made from Banana Creek on the Normanby to Ninda Creek on the Laura, by which the south-eastern extent of the coal measures might have been determined. The country appears as a blank on our maps, being exceedingly difficult of access, wherefore it was thought that for the purpose in hand—*i.e.*, the determination of bore sites—it would suffice to assume the boundary, as actually has been done. A complete circuit of the field was made, nevertheless, *viâ* Butcher's Hill head station, whence, had conditions allowed of it, a traverse was to have been made towards the north-west.

GEOLOGY.

The palæozoic sedimentaries, in several places pierced by granitic intrusions, making up the greater part of the coastal plain behind Cooktown, have in the not distant (geologically speaking) past been covered with a mantle of mesozoic sediments, as the cappings on all

the higher mountains witness. In some of the earliest reports it was shown that the mesozoic strata have a gentle dip inland, and that beyond the Battle Camp Range they completely hide the underlying slates and granites. They are made up in great part of sandstone, but from the time of the first settlement of the district the carbonaceous nature of certain horizons has been noticed, and a desultory search has been carried on for coal, a number of thin seams of which have been located. Cretaceous strata do undoubtedly exist on the north-west, and, owing to the absence of a strong unconformity, the mistake has from the first been made of regarding the underlying coal measures as of the same age; whereas the fossils contained in them prove them to be Trias-Jura—generally regarded as a far more promising age for coal than Cretaceous, at least in Australia.

In making traverses of the coal measures, some observations had to be taken on the general geology of the district, and brief notes on the various formations are appended.

Indurated Sedimentaries (of undetermined age): I have taken Mr. Maitland's charting* of the boundary of the area west of Battle Camp head station, but on the Normanby River my map differs from his considerably, no slates being shown below Mount Ruby head station as none was seen by me, though it is very likely they come quite close to the surface. The inlier found in the upper part of the Deighton River goes, with that at the 37-mile peg on the railway, to prove the continuity of the slates beneath the whole of field outside of the granite areas. These rocks have in several parts undergone induration, chiefly by silicification, as at the 37-mile peg and at Mount Ruby. On the Deighton they exhibit an augen structure, and much resemble the country rock of the Starcke Goldfield, while those exposed along the Laura are still more crushed, in some places having been completely converted into schist.

Several large quartz reefs were seen between Earl's and Bella Creeks (south of the Laura), but do not give promise of containing the precious metal. Alluvial gold has, however, been worked along at least two of the western tributaries of the Normanby River that have cut down into the slates. These are Banana and Old Man Creeks. Thick beds of well-rounded wash along Unnamed Creek (between that last-mentioned and Mount Ruby head station), also appear to be worthy of prospecting, though the absence of permanent water in the vicinity will have to be taken into account.

Permo-Carboniferous: Outcrops of Permo-Carboniferous coal measures do not occur within the Normanby-Laura Coalfield, but are found to the east and to the west, in both cases being overlaid by Trias-Jura strata. They have been fully described

* G.S.Q Publication No 70.

by Messrs. Jack* and Gibb Maitland,† and further notes on the Little River are shortly to be published by me.‡ The palæozoic coal measures comprise chiefly shales, and have been greatly disturbed, but exhibit little induration. They are marked by the presence of *glossopteris*.

Granite: In my opinion the Battle Camp and Mount Ruby granite areas are connected, as shown. The three small areas (one at the head of Unnamed Creek and others on the Deighton River) are of much interest, proving, as they do, the south-west-ward continuation of the *massif* beneath the coal measures.

The Battle Camp rock is macroscopically an ordinary ternary (quartz, felspar, and biotite) granite. Good exposures are not plentiful, but the alignment of the unweathered kernels is indicative of parallel jointing, and felsite dykes near the centre of the area also generally have a meridional trend. In the railway cutting on the divide, one mile west of the Battle Camp railway station, bunches of coarsely acicular tourmaline were noticed, with muscovite and quartz in the unweathered kernels, surrounded by decomposed rock. It was consequently not a surprise to learn that stream-tin had also been discovered in the vicinity, and that an attempt had actually been made to wash the dirt in the gullies east of Coal Mountain (about two miles west of Battle Camp railway station). The tinstone, seen in the residual soil, is fairly coarse, and exhibits crystalline faces, but no body of wash can be seen, and there is a great scarcity of water in the vicinity. On my return from the field Mr. J. W. Webb, the prospector, showed me tourmaline-bearing quartz-veined formation from one of the ridges above his claim—evidently the source of the tinstone.

This granite area is further characterised by thick bodies of "dog-tooth" quartz, generally without great length, and apparently barren of metallic mineral, but containing a little golden muscovite (?). One of these, 10 ch. south of the 36-mile peg on the railway, has an average width of 6 ft., and can be traced on an E.-W. line for 5 ch. Thin veins of pegmatite were seen in the country rock adjacent to this reef.

Less than 4 miles above Christie's coal crop on the Deighton, a large lode is exposed in the bed of the river. The immediate country appears to be an altered granite, though altered slate is to be seen within a few chains to the east. The lode, which consists of quartz with up to 50% arsenopyrite, and has a thickness of from 3 to 5 ft., follows a curved fissure, having a general trend from south-east to north-west. The country to the south-west of the lode has been

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* G.S.Q. Publications Nos. 6, 7, 35.

† G.S.Q. Publication No. 70.

‡ "Mercury Copper and Coal Mines, Little River, Cook District." Queensland Government Mining Journal, June, 1909.

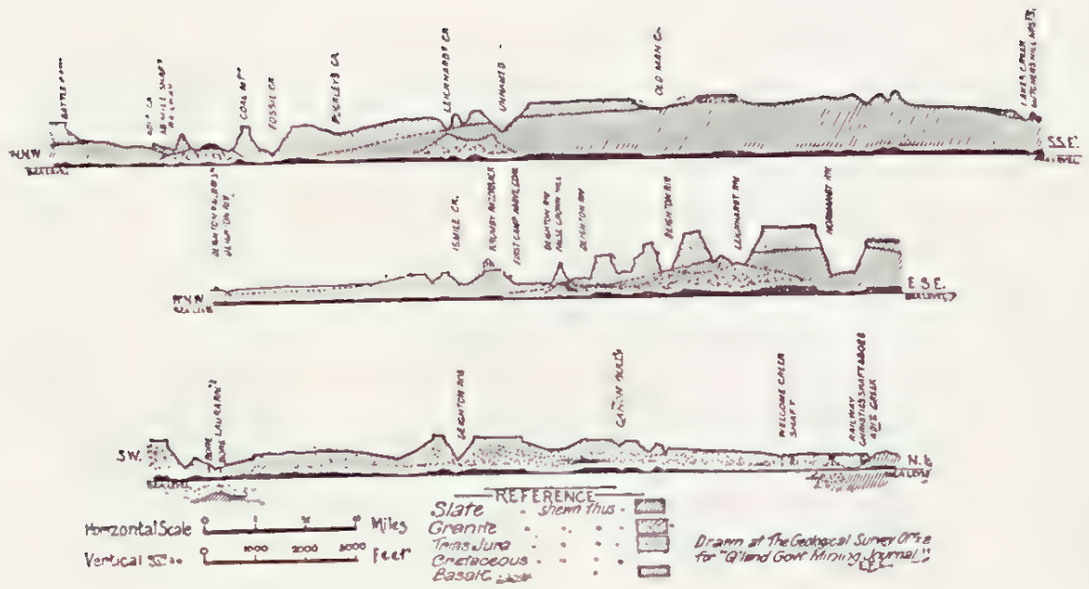

FIG. 1.—SECTIONS ACROSS THE COOKTOWN COALFIELD.*

NNW-SSE—From the Battle Camp R.S. to Butcher's Hill H.S.

WNW-ESE—From the Deighton R.S. to the Normanby River.

SW-NE—From the Laura R. to the 38-mile shaft.

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* Actual contours, on a scale of $\frac{1}{31680}$, are shown in solid black.

sheeted to some extent, and consequently is seamed with stringers and lenses of quartz for some feet. This was observed while on a rapid traverse, when time could not be spared for a detailed examination. Some prospecting should certainly be done along the outcrop.

The occurrence of tinstone and the minerals of pneumatolytic origin may be taken as strong presumptive evidence of genetic connection between this granitic area and that on the Annan Tinfield, 30 miles to the south-east.

Trias-Jura.

The Trias-Jura beds are predominantly arenaceous, thin beds of sandstone and conglomerate comprising at least three-fourths of the exposed strata. Bluish, micaceous, and often sandy shales are sometimes found, but only very occasionally are carbonaceous shales to be seen. In certain localities (Stack's Creek more especially) outcrops of clay-iron-stone are fairly numerous.

The basement of the coal measures has been conclusively proved to have a slight westward dip (about 1 in 200), but the strata themselves, though they have nowhere any considerable dip, have been thrown into slight undulations, over the whole field, which, together with the discontinuity of particular beds, renders it extremely difficult to correlate the outcrops in different localities. The average dip is certainly not greater than 1 in 100 over any distance. Mr. Maitland, working on his aneroid measurements, came to the conclusion that the Battle Camp strata are inferior to the Puckley's Creek beds described by him, but are superior to the Welcome Valley beds. With the latter part of this my observations agree, but there does not seem to be sufficient evidence for the placing of the Battle Camp strata beneath those at the head of Puckley's Creek.

It is safe to assume that deposition of the coal measures took place at about sea level, wherefore it follows there must have been a great elevation of the land within comparatively recent times. On geological data it can only be said that this elevation has been brought about since the Cretaceous era, but topographical evidence will probably show that the movement took place in late Tertiary times. It is proposed to refer to it in future as the Cook uplift.

Hitherto no recognisable plant remains have been reported from the coal measures, but in a quarry on the south-eastern side of Coal Mountain, which is equidistant (3¼ miles) from the Battle Camp railway station and from the 38-mile peg (in a direction west-south-west from the former and south-south-east from the latter) were found abundant *Taeniopteris*, *Brachyphyllum*, *Alethopteris*, *Taxites (?)*, and *Phyllotheca (?)*—criteria of the Trias-Jura age of the measures.

Mesozoic coal seams have been reported from seven localities in the Cooktown district, and to these have now to be added three more, making a total of ten, as in the following list:—

Guppy's Tableland [1]	8 in.
India Head [1]	——
Brannighan's Bluff [1]	——
Stack's Creek [2]	10 in.
Puckley's Creek (4 miles south of the railway) [3]	8 in.
... ... [1]	4 in. 9 in.
Welcome Vallley (2½-m. S. of 39-m. ¡ eg) [3]	8 ft. (?)
... ...	3 in.
38 Mile (shaft) [2]	10 in.
,, ,, adit [4]	10½ in. 9 in
... ...	15 in. 3 in.
Deighton River (Christie's)	
,, ,, (Top Crop)	7 in.
A. C. Creek (Wild Boar seam)	8 in.
Laura River [1]	2 in. 5 in.

[1] G.S.Q. Publication No. 70.
[2] ,, ,, ,, 106.
[3] ,, ,, ,, 35.
[4] ,, ,, ,, 180.

Stack's Creek.—The Stack's Creek workings are located on the eastern fall of the range dividing the Puckley's Creek catchment from that of the Normanby River, 3 miles south-by-east from the Battle Camp railway station.

One of the prospectors took me to see "Carter's seam," which was found to be that reported on by Mr. Jack, 13 years ago.* The greatest thickness of coal now exposed, at an elevation of 380 ft., is 9 in., this being overlaid by 5 ft. of blue shale, streaked with coal in the lower part. Above that again there are alternating sandstones, shales, &c., to the range top, which has an elevation of 975 ft. The base of the coal measures was found, by boring, as elsewhere mentioned, to be 600 ft. below the coal, the total thickness of measures here being consequently 1,200 ft.

The numerous crops of clay ironstone along the eastern side of this range would lead one to infer the presence of coal seams, which it has now been proved must, if existent at all, crop above that already described. Search was made for these, and resulted in the discovery of only a 3-in. coaly band, but this want of success may have been due to the frequent blanks in the section.

Welcome Valley.—At the head of one of the branches of Welcome Creek, between the Scraggy Point escarpment and the Coal Mountain mesa, at an elevation of 450 ft. above sea-level, several exposures of coaly sandstone and shale were examined, some of the shales containing bands of clay-ironstone. The dip, which is variable, never exceeds 10°, but evidence of some slight faulting is not wanting. Two shafts

* G.S.Q. Publication No. 106.

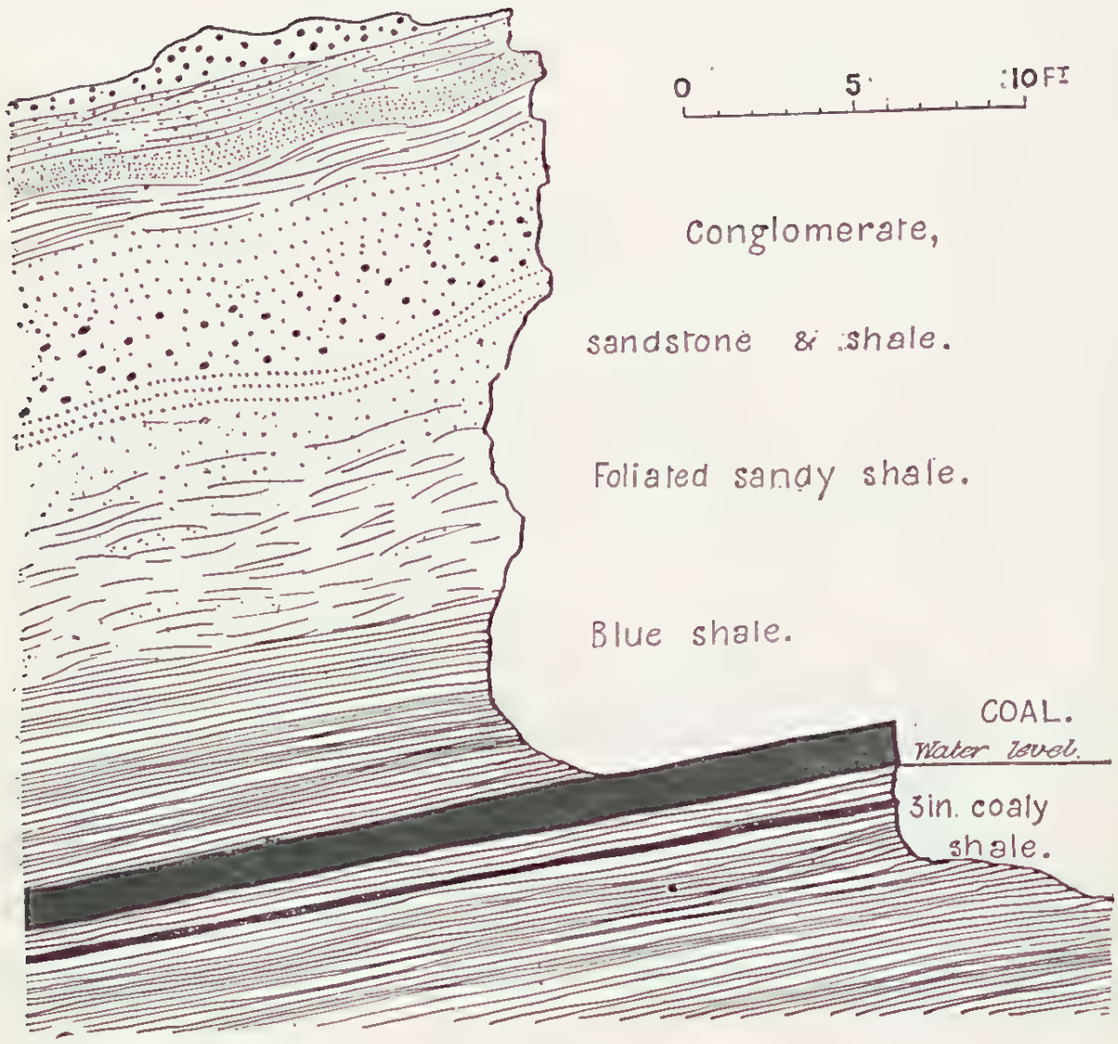

FIG. 2.—CHRISTIE'S COAL SEAM, DEIGHTON RIVER.

have been sunk here—one, in the creek bed, to a depth of 10 ft. in coaly sandstone (containing, it is said, one 3-in. seam of coal), and one on the high bank to a depth of 30 ft. in yellowish micaceous sandstone. Nothing was seen here to warrant the carrying out of any further development work in this locality.

Puckley's Creek.—Both Mr. Jack and Mr. Maitland have described* the occurrence of thin seams of coal at the head of Puckley's Creek, but the scarcity of water at the end of the year prevented my penetrating into this country.

The 38-Mile.—Christie's P.As. 28 and 29 are on the northern and southern sides of the railway line, between the 37 and 38 mile pegs. Christie's shaft, 5 ch. north of the 37 m. 50 ch. peg, is now inaccessible, owing to an inrush of water at 345 ft. from the surface in the bore put down from its bottom. A 10-in. seam of coal† was pierced at a depth of 119 ft., and it is believed that the bore bottomed on a second, which is most likely that opened by the adit. The latter is now caving in, but was, while being driven, inspected by Mr. Jackson, then Assistant Government Geologist. Its elevation above sea-level is 345 ft.; it lies half a mile north of the shaft, and is said to be 300 ft. long, but it was in such a state of collapse at the end of last year that we were able to penetrate only 50 ft. from the mouth. At that point there is exposed 11 in. top coal, separated by 7 in. shale from 3 in. bottom coal. The coal is jet black, well stratified, and breaks into cubes. There are thin bright laminæ, but much of the seam is dull earthy, and weathers white on exposure, owing to the high ash content,‡ which decreased only slightly with increased distance from daylight. The seam is said to have bulged to 2 ft. in one place, but the high percentage of ash prevented the placing of the coal on the market.

There seems to be no promise of the coal improving either in thickness or quality within any moderate distance to the dip, and the basement is probably at no great distance below the bottom of Christie's bore.

Deighton River.—Christie's crop on the Deighton occurs in a permanent waterhole in the river bed, and had never been seen by white man before our visit, when the water in the hole was abnormally low. The crop lies at an elevation of 325 ft. above sea level and about 1 mile south-west of a tree marked broad arrow above F over 1, $10\frac{1}{4}$ miles south-by-east from the Welcome Valley railway station, and $12\frac{1}{4}$ miles south-west-by-west from the Battle Camp railway station. The main seam has a thickness of 15 in., as shown in the section below (Fig. 3). The mean dip at the crop is 12° to the north-by-west. The coal is black in the mass, but has a distinctly brown powder, and the seam

* Op. cit.

† G.S.Q. Publication No. 106.

‡ See Bibliography, G.S.Q., No. 180.

shows several indistinct laminæ or penny-bands of dirt. Below are the analyses of a sample taken from the whole 15-in. face (Government Analyst):—

Sample C (No. 6).

Proximate analysis.

Moisture	=0·7%
Volatile hydrocarbon	=22·5%
Fixed carbon	=65·7%
Ash (red)	=11·1%
	100·0

Cakes with intumescence.

Ultimate analysis:

Moisture	0·70
Carbon	76·30
Hydrogen	4·70
Sulphur	2·70
Nitrogen	1·10
Ash	11·12
Oxygen (by difference)	3·38
	100·00

Evaporative power.

Weight of water at 100° C. converted into steam (by calculation) 13·89 lb.

This is a remarkably good analysis for crop coal, and is very similar to that of the bituminous coal of the North Bulli Colliery (N.S.W.). The seam is, however, far too thin for its exploitation to be considered at the present time.

Two miles east-by-north from the main crop a second (known as the Top Crop) was seen in the bed of the river. This seam is only 7 in. in thickness, and differs from that above described in being directly overlaid by sandstone. The dip is 20° to the west—*i.e.*, away from the small crops of granite and slate about a mile further up the river. The coal is black and breaks into cubes, but its powder is brown.

A. C. Creek.—The Wild Boar seam was found in the bed of A. C. Creek, at an elevation of 635 ft. above sea-level, 3½ miles south-east of Christie's crop. There is here 8 in. of good clean coal, with a shale roof and fireclay floor, dipping 5° to the north-west. The absence of coal fragments in the wash above this crop is fairly conclusive evidence that no seam of any size is exposed for several miles up the creek.

Laura River.—Mr. Maitland some 18 years ago reported* the occurrence of two thin seams (5 in. and 2 in.) in the Laura River about 5 miles above the railway terminus. These are at the crossing of the Butcher's Hill bridle track, and may still be seen. The coal,

* G.S.Q., Publication No. 70.

which breaks into cubes and has a brownish streak, appears to be of good quality, but is somewhat weathered at the surface. The seams dip 5° to the north, but the dip of the strata hereabouts is very variable, being sometimes to the south. The elevation is about 260 ft. above sea-level.

Cretaceous.

The country along the railway between the 52 and 66 mile pegs and for 6 miles east of the Deighton R.S., is shown as Cretaceous, not alone because of difference between the strata there exposed and those of the plateau to the east, but also because of the fossils fauna characteristic of it (*Rhynchonella*,* *Macoyella*,* *Tellina*,† *Pecten*,‡ &c.). That these strata formerly extended some distance along the railway line—perhaps to Puckley's Creek—is very likely, the thin beds of mottled sandstone and cement almost certainly being relics of the cover. The *Hinnites* and *Ostrea* found by Taylor§ to the north of the Battle Camp range and since unsuccessfully searched for by several geologists, are from the north-eastward prolongation of these Cretaceous strata. As, however, no opportunity to visit this locality offered, the Cretaceous area in the vicinity of Battle Camp H.S. is not shown.

The Cretaceous strata comprise soft, argillaceous sandstones, generally mottled red and white; hardened silicified red or white sandstones; and greasy shales in thick beds having little or no partings. The red sandstones have often disintegrated to loose sand, not red but white, for during successive rainy seasons it has undergone leaching by downward percolating surface water carrying organic acids, capable of dissolving the iron oxide pigments. A deposit of sandy cellular limonite has been produced some feet beneath the surface, by precipitation of the iron oxides.

Basalt.

The basalts of the Cooktown District are the youngest of the rocks exposed. They generally occur along the valley bottoms of the present drainage system, and they are, without any doubt, younger than Trias-Jura. The discovery of the remains of a cinder cone in the upper valley of the Endeavour River gives reason to believe that the flows took place quite recently, a very brief period of geological time being required for the total degradation of the greatest cinder cone. The flows observed at the head of the Laura River, on the Butcher's Hill run, may quite possibly have had its source at the

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* Found by Mr. Maitland at the near 55½-mile peg.

† Given me by Mr. Foley, as from the 55-mile peg.

‡ Found by me at the 54½-mile peg.

§ See G.S.Q. Publication No. 35.

junction of Lakes Creek with the West Normanby River, the elevation of the basalt mountain there being quite sufficient for the flooding of the Butcher's Hill country from it; that, of course, necessitating the assumption that Lake's Creek at that time flowed south and westwards instead of northwards as now.

The frequent occurrence of these basic volcanics along the valley bottoms and among the mesas along the inner edge of the coastal lowlands is suggestive of the volcanic activity having been due to the production of cañons and mesas, with consequent disturbance of the isogeotherms and weakening of the crustal arch, but at the same time it is probably genetically connected with extensive fissuring brought about during the Cook uplift.

BIBLIOGRAPHY.

Rather extensive quotations are given (in small type) from the works of previous writers, as several of them are out of print and difficult to obtain.

Progress of the Search for Coal in the Cook District (G.S.Q. Publication No. 6). By Robert L. Jack, Govt. Geologist., Bris. By auth., 1879.

Specially referring to the Little Oakey and Deep Creek (Permo-Carboniferous) coal measures, but mention is made of the caps of horizontal sandstone and conglomerates.

Second report on the Progress of the Search for Coal in the Cook District (G.S.Q. Publication No. 7). By Robert L. Jack, Brisbane. By auth., 1879.

Re the existence or non-existence of valuable coal seams in the horizontal sandstone formation, which "correspond in every particular with Daintree's description of the cainozoic "Desert Sandstone" of the western interior. . . . ."

On a visit to the mountains on the north shore of the estuary of the Endeavour, Mr. Jack found "conglomerate separated from an overlying bed of sandstone by about 4 feet of grey shales, the uppermost 8 inches of which were mixed with thin layers of coal. . . ."

Geological Observations in the North of Queensland, 1886-7. (G.S.Q. Pub. No. 35.) By Robert L. Jack, Bris. By auth., 1887.

Description of the railway between 32 mile and 50 mile pegs.

Tyrell's shaft was being sunk 1 mile to the south-west of the 39 mile 60 chain peg.

About 300 yards south-south-west of the shaft a branch of the Welcome Creek exposes some black shale with coaly streaks. Two miles south-east of the new shaft another shaft has been sunk in the bed of a gully below a waterfall, the locality I judged to be about 100 feet above the level of Tyrell's shaft.

In the bed of the gully could be seen 10 ft. of grey sandstone with coaly streaks 10 ft. over 8 in. of black sandstone.

The coal is said to have been sunk on for 8 feet. . . . The coal had a specific gravity of 1·83, and on analysis gave the following results :—

Moisture	8·25
Volatile hydrocarbons	30·42
Fixed carbon	42·31
Ash (siliceous)	19·02
	100·00

At 41 miles 62 chains Mr. Webb informed me that a 2-in. coal seam was exposed by a man engaged in breaking railway ballast.

About 2 miles above the railway (southward) the creek [Puckley's] falls about 50 feet over a wall of granite, which is capped by horizontal beds of gritty sandstone.

Three miles south of the railway up Puckley's Creek Mr. Jack found grey sandstones containing imperfectly preserved plant remains and little kernels of very good coal. The dip is 7° to the north. One mile further south an 8-in. seam of coal had been reported, and one mile beyond that Mr. Jack found a 1-in. seam of coal, 10 in. below which there was said to be a seam 1 ft. 6 in. thick (under water), an analysis of which was:

Moisture	7·16
Volatile hydrocarbons	20·96
Fixed carbon	35·35
Ash (felspathic)	36·53
	100·00

Regarding the age of what I have called for convenience sake the "Coal Measures," I could ascertain little or nothing. I searched in vain for any recognisable fossils, but with the exception of plentiful carbonaceous streaks, representing decayed plant remains, I could find nothing.

The Geology of the Cooktown District. (G.S.Q. Pub. No. 70). By A. Gibb Maitland, Assistant Geologist. Bris. By auth., 1891. With geological sketch map of the Cooktown District.

After referring to the Permo-Carboniferous areas, Mr. Maitland, under the heading of "Desert Sandstone Rocks," describes in some detail the sandstones and associated coals of this district, as well as the outliers to the east (Brannighan's Bluff, Connor's Knob, Mount Fantastic, Guppy's Tableland and India Head). He shows that the base of these strata on the coast is 800 ft. above sea-level, and that it has a gradual slope westwards, being only about 400 ft. [300 ft.] above sea-level near the Normanby railway station, and at the 37-mile peg on the railway; and further, that the strata west of the Normanby and north of the Palmer waters are depressed into the form of a basin.

The strata exposed along the railway line between the 37-mile peg and the 55½-mile peg, those at the head of Puckley's Creek and

others 5 miles up the Laura from the railway, were examined; and it is concluded that the strata of the Battle Camp Range are inferior to those at the head of Puckley's Creek, but overlie the Welcome Valley beds, which thus should have a cover of not less than 1,000 ft.

With regard to the age of the Welcome Valley beds, Mr. Maitland says, "subsequent examination shows them to be of desert sandstone age," but the only reference to the discovery of fossils, beyond "a few plant remains, rootlets, and fragments of leaves" from Guppy's Tableland, "reed-like plants, too fragmentary for determination," in one of the branches of Welcome Creek, and "annelid tracks" from Battle Camp Range,* is the following:

> In the vicinity of the 55½-mile, within 200 yards of the line on the south, a series of fossils were collected from a bed of fairly coarse grit which occupies the greater portion of the neighbourhood. The fossils, which resemble very closely those occurring in the desert sandstone of Croydon, consist of Macoyella(?), internal casts of Rhynchonella, and others which I have not yet been able to determine.

Admitting this evidence as conclusive of the Cretaceous age of the rocks at the 55½-mile, I have shown above that it does not necessarily apply to the coal measures.

The occurrence of coal at the following localities is described and a set of four analyses is tabulated, but only that of the Guppy's Tableland coal would meet ordinary commercial requirements.

Guppy's Tableland (and India Head): A 6-in. seam (containing 9·65% ash) in shales and sandstones, exhibiting coal streaks both above and below.

Moisture	2·32%	Sp. qr. 1·66
Volatile hydrocarbons	15·20%	
Fixed carbon	72·83%	
Ash	9·65%	

Laura: 5 in. and 2 in. seams separated by 5 ft. 6 in. of sandstone and shale.

Puckley's Creek: A 15-in. seam (including 2 in. grit and 3 in. carbonaceous grit), the best of which contained 30·20% ash.

Coal near Cooktown (G.S.Q. Pub. No. 106). By Robert L. Jack, Govt. Geologist. Bris. By auth., 1895.

This refers to operations at the 38-mile peg and at Stack's Creek.

At the former place the Christie Bros. sank a shaft 246 ft. 2 in., and from the bottom put down a bore 99 ft. 7 in.—in sandstones, shales, and ironstones. In the shaft at 119 ft. 9 in. a seam of coal, 1 ft. 3 in. thick, was struck (10 in. of this contained only 12·40%

* With regard to Mr. Norman Taylor's discovery of *Hinnites* and *Ostrea* hereabouts, see elsewhere.

ash). Mr. Jack was of opinion "that the bottom of the bore had reached a point not far above the junction of the possibly coal-bearing formation with the older metamorphosed or plutonic rocks" which occur to the east and south.

Mention is made of a drive below the sandstone cliffs at Stack's Creek, and a section showing 10 in. clean coal separated by 1 ft. 3 in. of shale from a 1-in. streak of coal. A test of this coal was made on a locomotive with very satisfactory results. Half a mile down the creek, 170 ft. vertically below the coal, a hand-bore proved 192 ft. of sandstone, shale, and ironstone without coal. Mr. Jack concluded thus:—

> The surface of the old rocks (granite and slate) must be uneven, as the bore has already penetrated through newer rocks to a depth of 62 ft. below the level of the granite in the Normanby River. I look with strongest hope for payable coal seams to the 170 ft. of unexplored strata between the drive and the bore. . . . . In all probability a bore 600 ft. deep, commencing at the drive, would bottom on the granite or palæozoic rocks, and settle, once for all, the question of the existence of payable coal in the district. I beg leave, therefore, to recommend, in the public interest, that a diamond drill be sent to bore 600 ft. from the drive on Stack s Creek.

Recent Prospecting of the Cretaceous Coals of the Cook District (G.S.Q. Pub. No. 180). By C. F. V. Jackson, Assist. Govt. Geologist. Bris. By auth., 1902.

Mr. Jackson gives a brief historical *résumé* of the work done by previous observers, and agrees with them in regarding the coal measures as of Cretaceous age, though he adduces no further palæontological evidence.

It is stated that during 1896 Messrs. Kortum, Fitzgerald, and others carried on the diamond-drilling at Stack's Creek recommended by Mr. Jack, without striking coal, though continued to the granite at a depth of 600 ft.

In 1902 Messrs. Christie Bros. began driving on the seam ½ mile to the north of their shaft, at the 38-mile peg, and the following section at the mouth of the adit is given:—

Soft grey shale	2 ft. 0 in.
Grey carbonaceous shale	1 ,, 9 ,,
Upper *coal*	10½ ,,
Grit y carbonaceous shale	7½ ,,
Lower *coal*	9 ,,
Under clay	1 ft. 0 ,,

Four samples were analysed:

—	Moisture.	Volatile hydrocarbon.	Fixed carbon.	Ash.
Upper seam	0·80	18·30	41·80	39·06
Lower ,, ...	1·645	17·89	33·95	46·51
Stacked (30 tons)	1·025	20·185	42·45	36·34
50 ft. in adit	1·35	19·00	42·94	36 35

These show the coal to be too poor in quality for economic use, and that there has been very little improvement at a distance from the crop.

Mr. Jackson says, "there is every reason to believe that the Stack's Creek outcrop and that opened up at the $37\frac{3}{4}$ mile represent the same seam"; but these two localities are 7 miles apart, and separated by a considerable area of granite, and I am therefore not satisfied that the evidence offering is sufficient for this connection to be made. The report concludes thus:

> Though with the help of the additional stratagraphical information since obtained, the site for a bore would have been more advantageously chosen to test the Welcome Valley beds to the west of the 38-mile, there is not much doubt that even if the whole of the beds were not represented at Stack's Creek very little of the formation below the coal remains unproved . . . . the prospects do not appear sufficiently favourable to warrant any very large outlay.

Brisbane, 19th March, 1909.

MERCURY, COPPER, AND COAL MINES, LITTLE RIVER, COOK DISTRICT.

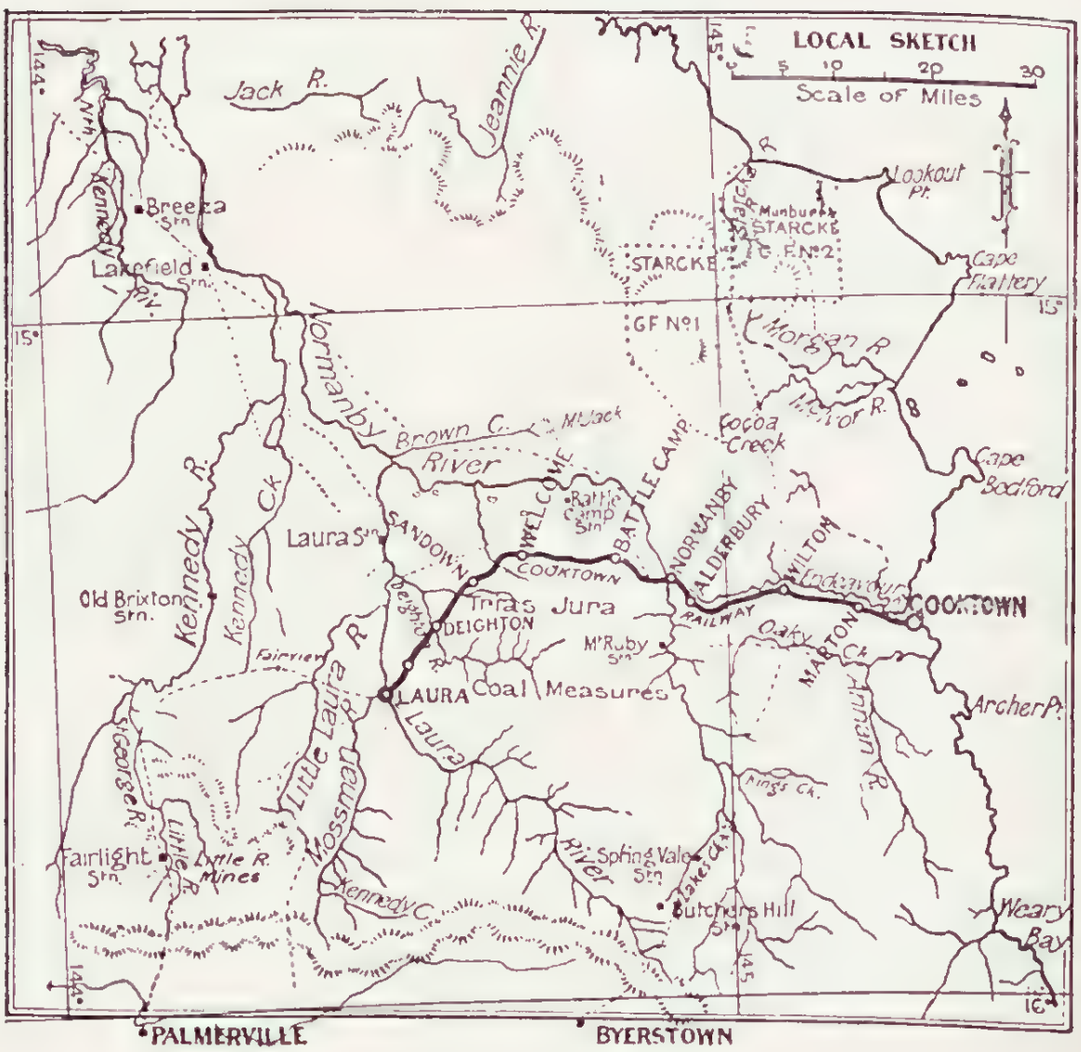

FIG. 1.—LOCALITY PLAN.

MERCURY, COPPER, AND COAL MINES, LITTLE RIVER, COOK DISTRICT.

Introduction.

In compliance with repeated solicitations, a visit was paid to these mines at the end of 1908, under the guidance of Mr. A. Christie, one of the prospectors, acting on behalf of the St. George Copper and Coal Mines, Limited.

The site of Fairlight homestead is 30 miles distant from Laura, the Cooktown railway terminus, in a direction west 30 deg. south, and access to it may be had either by a fairly straight bridle track across the intervening ranges or by the mail road down the river and round the ranges, the total distance in the last case being about 60 miles. To build a line from the Laura to Fairlight, a distance of 31 miles, it has been calculated by a railway engineer (Mr. Monk) would cost £110,220.

The company's holdings comprise a prospecting area of 160 ac., two mineral leases (Nos. 198 and 199), each of 20 ac., and a coal prospecting area of 640 ac. The Little River runs diagonally through the C.P.A., in about the centre of which is the site of the homestead. The P.A. and mineral leases all lie within half a mile to the east of the C.P.A. Other holdings now abandoned are M.L. 174, or the St. George No. 1 South (extending from the P.A. to the southern edge of M.L. 199); M.L. 184, or the Great St. George (extending southwards from M.L. 199); and M.L. 175, or the St. George No. 2 North* (to the north of the P.A.).

GEOLOGY OF THE DISTRICT.

The coalfield was examined and mapped in detail by Mr. Jack† in 1882, and eleven years later additional notes on the coal were published by Mr. Rands.‡ Two years ago Mr. Cameron, Assistant Government Geologist, examined, but did not report on, the mines. As will be mentioned below, he made several observations on the country rock in shafts now inaccessible, and has been good enough to pass the information on to me.

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* My guide did not seem to be aware of the fact that there are several shafts on the forfeited lease No. 175, and they were consequently missed by me. Mr. Cameron, however, tells me that they were sunk in shale, and that only thin leaders of copper ore were found in them.

† The "Little River Coalfield, near Cooktown." By Robert L. Jack, Government Geologist. Bris.: By auth: 1882. G.S.Q. Publication No. 11.

‡ "Geological Observations in the Cooktown District." By William H. Rands, Assistant Govt. Geologist. Bris.: By auth.: 1893. G.S.Q. Publication No. 91.

The Plateau Sandstones.

In Trias-Jura times the whole of this district, including the coal measures and the metalliferous altered rocks, were completely covered by coarse-grained sandstones and conglomerates, as witness the table-land to the west of the Little River and the ranges between Fairlight and the Laura, the intervening portions having been denuded in comparatively recent times. The earlier geologists provisionally referred these strata to the Cretaceous system, but the fossils lately found in the valley of the Deighton River show similar rocks there to be of Trias-Jura age.*

The Coal Measures.

The coal measures have been shown by Dr. Jack to extend along the Little River in a narrow strip from above its confluence with the 19-Mile Creek to below its junction with the St. George River. They have thus been proven over a length of 6 miles, but the average width is only three-quarters of a mile. The presence of *glossopteris* has led to these beds being regarded as of Permo-Carboniferous age. The coal measures are believed by Dr. Jack to be cut off on both the east and the west by extensive north-south trending faults.

Fifteen coal or smut crops were found by Mr. Jack, of various thicknesses up to 18 ft.; but none of those in the vicinity of Fairlight met with his approval. Specimens from the upper part of the shaft in Dave Creek, to be referred to below, were found to contain 31% ash, and Mr. Rands, eleven years later, obtained, from a depth of 70 ft. in the same shaft, samples which, although consisting of the best of the seam, contained 6% and 10% of ash, and the report was therefore decidedly adverse. The result of tests made on the Cooktown Railway showed that the coal was not suitable for steam purposes, the "ashes" produced being 33% and 41%. Unfortunately no mention is made of the composition of this ash, and it is probable that it includes much unconsumed carbon, as the coal is friable and would with ordinary handling simply trickle between the grate bars.

The high fixed carbon content of this coal makes it specially suitable for use in gas-producers, and, in view of the probable extensive use of these in the future in Queensland, it is advisable that more prospecting be carried out to test the extent and quality of the Little River coal.

Wherever exposed, the seams are tilted at a high angle, and there is no likelihood of their flattening out within the limit of the field. There is a possibility of the same seams, however, being of higher grade to the westwards, even if they have there been subjected to abrupt folding, and additional prospecting, preferably by boring, would therefore be justified. Some boring was done 15 years ago by

* See "A Geological Reconnaissance of Part of the Cooktown Coalfield." By Lionel C. Ball. "Q.G.M. Journal," Apr., 1909.

the Fairlight Coal Syndicate on the flat in the western part of mineral selection No. 3016, which is 2½ miles north-north-west of the Fairlight workings. It is understood that the drill was of the jumper type, and any results obtained by it would be unsatisfactory.

The Metalliferous Country.

The coal strata are limited both east and west by highly indurated sedimentaries of unknown age, but presumably greater than that of the coal measures. Interbedded in these to the east of Fairlight occur flows of amygdaloidal andesitic lava,* which is the country rock of the copper and mercury ore deposits, and which has, in the vicinity of the two classes of ore, suffered quite distinct alteration.

A very interesting series of secondary minerals may here be collected, and from a macroscopic study of the rocks it may be shown that ferro-calcite was the first of the alteration products. This mineral occurs in the form of amygdules, filling the numerous steam holes in the lava. Calcite very generally occurs in cracks, but has often been replaced by jasper. One of the latest minerals to be developed was epidote, and that where the rock has been subjected to more or less pressure. Kaolinisation or sericitisation of the rock has taken place in the vicinity of the mercury ore, and jasper is wanting, there being instead much bluish chalcedonic quartz. The amygdules here also are quite unaltered.

The copper ores are found without mercury in only slightly altered andesites on each of the holdings, and also to a limited extent with cinnabar in the kaolinised and sericitised rock in the south-western corner of the prospecting area. Most attention has hitherto been given to the copper deposits, but very little evidence offers of there being any workable ore-bodies here. There are no gossan crops, and no continuous ore-body has yet been met, the principal indication of chemical activity being the jaspers met in all the copper workings. This mineral has in most cases replaced calcite, which sometimes can be shown by the included amygdules to have replaced the andesite. Mr. Cameron tells me that he observed in the now inaccessible shafts on M.Ls. 198 and 199 that the ore occurred on or near the tilted contact of slate and lava; that is, on surfaces which may be as extensive as true fissures, and there is consequently just a possibility that ore-bodies may be found if sinking be continued.

Prospecting for mercury ore should be carried out wherever the andesite has been greatly altered, as in the south-western corner of the prospecting claim, and it is to be looked for in calcite rather than in silicified areas, where copper is more likely to be found. It is probable that the alteration of the andesite in the vicinity of the cinnabar has been brought about by the action of fumarolic vapours.

* Mr. Jack does not refer specifically to lavas or andesites, but he mentions "greywackes and slates . . . . partially metamorphosed into porphyries, quartzites, etc.," auriferous in the immediate neighbourhood.

THE WORKINGS.

These properties have produced a ridiculously small quantity of shipping ore—a total of only 5 tons, yielding 24% copper; while of similar, or rather poorer, ore there is now at grass not more than another 5 tons.

Nearly a score of shafts have been sunk to various depths between 15 ft. and 92 ft., but the average depth is only 30 ft. It is stated that the reason for there being so many shallow shafts is that a heavy body of ground water, especially in the wet season, is met within 20 ft. of the surface. It being found impossible to sink on the ore, vertical shafts have been begun within a few feet of the outcrop, but have had also to be abandoned without attaining much greater depth than the original shaft.

The St. George (Prospecting Area).

(i.) The Camp workings in the south-western corner of this area comprise three shafts: The western, 25 ft. deep, has a drive for 18 ft. to the west, 10 ft. below the surface; the central, 10 ft. to the east and 17 ft. deep, has caved in; and the eastern, 5 ft. to the east-north-east, is yet in country, at 17 ft. depth, which is stated to be the water-level in the wet season.

This is the site of the discovery of copper here in 1905. There is no defined lode, and, from what can be seen now, it is to be assumed that the ore occurred in small bunches on an east-west line in the decomposed amygdaloidal andesite. It consisted of cellular siliceous and ferruginous (yellow) gossan with drusy crystals of azurite and stains of malachite, and dense limonite with specks of chalcocite and bornite. Cinnabar is sometimes present in the limonite to the extent of 25%, and also occurs as patchy impregnations in the completely kaolinised andesite. The richest copper ore came from the central shaft, but the quantity available can be gauged from the fact that only half a ton has been shipped—part of a parcel carrying 25% copper.

The richer cinnabar ore came from a band of kaolinised andesite in the western shaft and drive. In the drive the width of the so-called lode was 18 in., but towards the shaft bottom it is only 6 in. The alteration of the andesite has produced abundant thin veins of calcite, but very little quartz; and the cinnabar is found almost exclusively in cavities and on joints in the former. A little chalcocite was observed in the calcite, but no native copper could be found. A trial lot of 1 ton of picked mercury ore was shipped to London, and it is understood that the reports of certain firms showed that it contained 5 or 6% mercury, but, owing to the copper content, was

unsuitable for treatment by them. Almost 3 tons of ore are still at grass. A rough sample taken from the surface of this heap yields (Government Analyst):—

Mercury	...	3·00%
Copper	...	5·00%
Silver	..	1 oz. 4 dwt. 9 gr. per ton
Gold	...	trace.

(ii.) The Mercury workings lie 7 ch. north-north-east of the Camp workings. They are in an area of altered (sericitised?) andesite, 2 ch. long and 1 ch. wide. Bluish chalcedonic quartz veins are comparatively abundant, and the andesite has in places been changed into light and dark quartzite. Elsewhere within the altered area the andesite is cellular and ferruginous, and contains minute specks of cinnabar.

The main Mercury shaft was sunk 10 ft. vertically, and then 20 ft. on the underlie to the north-west, but has been filled in to the bottom of the vertical portion. No. 2 shaft, 15 ft. to the north-north-east, is still in country. From the latter a deep trench runs for 20 ft. to the west.

Nothing but altered country can be seen in the main shaft, which was descended; but there is at grass about a hundredweight of friable ferruginous andesite. This contains specks of cinnabar, and is said to have come from the bottom of the shaft. A sample of this ore has been assayed as follows (Government Analyst):—

Mercury	...	0·30%
Copper	...	0·3%
Silver	...	2 dwt. 14 gr. per ton
Gold	...	trace.

The copper is accounted for by splashes of chalcocite in the more siliceous parts of the ore. No shipments have been made from here.

A rough sample of the fragments thrown out of the long trench was also taken, specks of cinnabar being frequently visible. Its assay is (Government Analyst):—

Mercury	...	0·14%
Copper	...	0·20%
Silver	...	2 dwt. 19 gr. per ton
Gold	...	trace.

(iii.) The P.C. workings are 15 ch. north-east of the Mercury workings. These comprise the Prospector's shaft, which was 40 ft. deep, but has caved in; the Company's shaft, which is 5 ft. to the west and 46 ft. deep, but has been rendered inaccessible by the burning out of its timbers; and a trial shaft, 10 ft. deep and 10 ft. to the east-south-east of the Prospector's.

The ore found in the Prospector's shaft occurred in bunches up to 3 ft. thick. Of the seconds there is about 1½ tons at grass—silicified andesite and iron-stained cellular country, stained with blue and green carbonates and carrying probably little more than 5% copper, but no visible cinnabar.

No ore was obtained in the trial shaft.

The Company's shaft was sunk in calcite-veined amygdaloidal andesite, but towards the bottom a little copper pyrite made an appearance. There is now at the surface ½ ton of the ore raised, which consists of andesite, veined with calcite and quartz and replaced by calcite and jasper, associated with a little disseminated chalcopyrite. The copper content is probably no more than 1%, but all the richest blocks have been removed by visitors. The jasper here is veined with calcite, and seems to have replaced ferro-calcite, which has been deposited wherever cracks have been produced in the andesite. It is associated with a little epidote, and pyrite crystals occur in the calcite.

The St. George No. 1 (M.L. 198).

The workings, known as the Jasper shafts, are in the north-eastern corner of this lease. The main shaft is 96 ft. deep, and at the 92-ft. level has a drive running 48 ft. to the westward, but at the time of my visit could not be examined because half full of water. The underlie shaft, 75 ft. west of the main shaft, is 17 ft. deep, but inaccessible because lately burnt out. Ten feet south-south-west of this underlie there are two old shafts 5 ft. apart, and 17 and 15 ft. deep respectively.

Most of the ore obtained on this lease came from the last-mentioned shaft, at which is still stacked a ton in bags. It is ferruginous and cellular, and shows both malachite and azurite, together with finely crystalline glance, and, as bagged, should carry at least 20% copper. The country here is andesite, with much quartz-veined jasper, associated with foliated hæmatite and a little epidote.

At the underlie shaft there is paddocked about 5 cwt. of ore, chiefly jasper stained with malachite, which also fills what appear to have been cellular parts prior to the introduction of the jasper. The copper present is not above 5%.

The main shaft has not yet produced any copper ore, but one of the prospectors informed me that specks of native copper were appearing in the face of the drive. This may, however, have been pyrite or chalcopyrite.

Some most beautiful ornamental stone is available here, as a result of changes in the andesite, which exhibits various shades from slate colour to purple and dark-green, and is veined with light-green

and yellow epidote, besides having scattered amygdules of white calcite and red jasper. In places the body of the rock has been completely changed to calcite, which includes the original amygdules of ferrocalcite.

THE ST. GEORGE No. 2 (M.L. 199).

(i.) The Gully and Graham's shafts are in the north-western corner of this lease. The former is 30 ft. deep on an underlie of 1 in 1 to the east-north-east, and is now partly filled in; the latter is 20 ft. deep and vertical, but, the bottom ladder being missing, could not be examined.

The Gully shaft must have been sunk on a pipe of ore, the whole of which has been removed, for to within a few feet of the bottom only country rock can be seen. This is amygdaloidal andesite, but two years ago, while operations were in progress, Mr. Cameron was able to get to the bottom, and noted that shales separating two lava flows were then visible. Some 5 tons of ore were secured here, half of which has been sent away. The carbonate ore at grass consists in great part of jasper, but contains some glance, is well encrusted with malachite, and has traces of azurite. It should run over 10% copper. The glance ore paddocked contains traces of malachite and azurite, and at first sight looks to be chiefly chalcocite, but really contains jasper throughout. The copper content is at least 30%. The latter ore is without doubt replaced andesite, as occasional fragments show chalcocite to be uniformly distributed through a quartzose rock, carrying granules and lenses of ferrocalcite (the original amygdules).

(ii.) The No. 1 Underlie and Nethercote's shafts are in the south-western corner of the lease, 25 ft. apart. The former is said to be 35 ft. deep and to underlie 3 in 1 to the eastwards, but, the upper timbers having been removed, it has caved-in. The latter shaft is 29 ft. deep and vertical; and a drive runs westwards for 6 ft. from the bottom. Ladders having been removed from the shaft, no descent could be made.

To judge from the tips, one would take the country rock here to be andesite. That from the underlie exhibits, where weathered, a slightly schistose structure, but that from the vertical shaft has been crushed and plicated, and then replaced by calcite and jasper as well as veined with quartz and calcite, more especially between the separate crenulations of the contorted country. Mr. Cameron however, in descending the underlie found the upper part to be in mudstone shales, the andesites forming a hanging-wall to the copper ore.

Only 2 tons of ore was shipped from here. The ½ ton at grass consists chiefly of silicified andesite, with limonite, malachite, and glance, and containing an average of 30% copper. Much brown jasper was found, sometimes exhibiting graduations into horny chalcedony, with attached ferro-calcite and epidote.

The Coal Prospecting Area.

As had been foretold, little if any more could be seen at the end of last year than had already been reported on by Messrs. Jack and Rands. Some exploration work had been carried out by the company, but the workings were, for various reasons, inaccessible. Before any reliable geological work can be carried out here some development must be done to expose the crops.

The largest of the crops seen is that of the 8-Ft. seam, in the right bank of the river, ¼ mile east of the site of Fairlight station and within ½ mile to the south-west of the Camp copper-mercury workings. A cut into the bank exposes 7 ft. of this seam, which dips 3 in 1 to the south-west. Behind the seam, and separated from it by 18 in. width of a white calcareous clay, is a second band 2 ft. 6 in. wide of coal smut, beyond which there are *glossopteris* shales. The coal is much weathered, and has a herring-bone structure, which is due to the large proportion of contained calcareous impurity. If the smut be sunk upon, it will be found to change into coal, which may be of good quality. Nethercote's adit, 2 ch. to the north-west of the cut, was put in 80 ft. (nearly double the distance expected), and proves the continuation of the 8-Ft. seam, but has, unfortunately, been allowed to cave-in.

The 3-Ft. seam is exposed at the mouth of Nethercote's adit, where it strikes north-north-west. It has been sunk upon between 30 and 40 ft., Davy lamps having to be used in sinking because of the large quantities of gas tapped. It has been filled in again. The coal said to have come from this shaft is bright, and breaks with a cubical fracture.

The country in the vicinity of these workings has been much disturbed, in one place on the river bank having been quite bent back upon itself. The trouble might be accounted for by faulting, the abundant calcareous sinter being strong evidence in favour of that supposition.

The 4-Ft. seam crops in Dave Creek, ½ ch. above the river. At the surface it is simply a coal smut, dipping 80 deg. to the west-south-west. The prospectors sank a few feet on this, and found coal, which could be burnt in an open forge. The hole has since fallen in.

The 6-Ft. seam crops as a coal smut, 5 ch. north-east of the mouth of Dave Creek. The shaft in the bed of the creek is full of water, but from Mr. Rand's report* it is learnt that it was sunk to a depth of 100 ft., the dip being 12 in 1 to the east. Mr. Rands saw 8 ft. of coal in one place, but subsequent to his inspection a crosscut proved the thickness of the seam to be 20 ft. The coal was much broken up by faults at 26 and 71 ft. depths, and had a dirty stony appearance,

* *Op. cit.*

but burnt in an open grate with a blue flame. The following is the analysis of Mr. Rands's picked sample of the best coal (Government Analyst):—

Moisture	2·14%
Volatile hydro-carbons ...	9·41%
Fixed carbon	82·38%
Ash	5·94%
Sulphur	0·13%
	100 00%
Sp. gr. ... 1·365	

Floods have now swept away the whole of the waste raised from the shaft, but on the bank above there is ½ ton of coal, which, my guide stated, came from the shaft. This is in lumps up to 9 in. in diameter, and after 15 years' exposure is quite bright but not free from crush faces. A sample was taken of the smaller chips, and has been analysed for the following return (Government Analyst):—

Moisture	2·2%
Volatile hydro-carbons ...	7·8%
Fixed carbon	79·5%
Ash	10·5%
	100·00%

Allowing that the coal raised was not suitable for burning in locomotives, as was proved at the time by tests on the Cooktown Railway, it is possible that the character of the coal will improve at a distance from the faults met in the shaft; and in order to further test the seam the company sank a shaft, 2 ch. to the south of the creek, but abandoned the project after sinking 20 ft.

The 18-In. seam is exposed on Dave Creek just below the eastern boundary of the P.A. It consists of 12 to 18 in. sooty coal streaked with sinter, and strikes north and south.

The Top crop on the river is just within the south-eastern corner of the P.A. There can here be seen bands of coal up to 18 in. thick, interstratified with sandstone and shale, the whole dipping, on the average, 1 in 1 to the east. The country is much troubled and slightly faulted.

Green's Flat Seam crops in the bed of the river, but at the time of my visit was below water. It has been proved to have a thickness of from 3 to 5 ft. in Higgins's shaft, 3 ch. north-west of the top crop, and there dips 1 in 1 to the north-west.

THE MERCURY DEPOSITS OF THE WORLD.

A brief reference to other occurrences of mercury may, on account of their comparative rarity, be permitted in this place. Kemp* states that the ores of quicksilver occur quite invariably associated with igneous rocks, which the literature of the subject shows are frequently andesitic in composition; and, as to the method of introduction of the metal, Beck is quoted to show that it has come up in solution as a double alkaline sulphide, generally impregnating porous rock rather than metasomatically replacing it.

* The "Ore Deposits of the United States and Canada." By J. F. Kemp; p. 427.

The world's output of mercury varies considerably in different years, and on the whole has, during the last decade, shown a slight decrease—the production for 1898 having been 3,750 tons, while that for 1906 was only 3,300 tons. This has been brought about, to some extent at least, by the fall in prices from £9 8s. in 1900 to £7 4s. in 1906.* During the last two years there has, however, been a slight recovery in prices, the latest London quotation to hand being £8 7s. 6d. per flask of 75 lb.†

Spain, Austria, Italy, Russia, and Hungary all produce mercury in quantity and in the order given.

At Almaden, in Spain, veins over 20 ft. in thickness occur in Upper Silurian slates.‡ Above the 12th level 400,000 tons of mineral, carrying nearly 8% of mercury, are stated to be available. This represents supplies for 25 years; besides there is twice this quantity of ore below the level. Late financial losses, have, however, shown the necessity of modernising the methods of mining and treatment in use.§ At Idria there are stockworks in Lower Triassic breccias and fissures in limestone of the same age. The lodes are 3 ft. wide, and average about 1% of mercury.‖

Of Asiatic deposits those at Kwei Chau are believed to have great possibilities.

The chief mines of the United States are at New Almaden, New Idria, and Sulphur Bank (all in California), and Steam-boat Springs (in Nevada). The country rock in the first and second is metamorphosed sedimentary, it is basalt in the third, and andesite and basalt in the last. Most of the Californian deposits are showing signs of exhaustion, and the output is lessening year by year, although ore containing less than 1% of the metal can be profitably handled in localities where there are already extensive reduction works.¶

Several large deposits are being worked in Mexico, the ore carrying only 0·8% mercury** in one of the mines, but the industry does not thrive, owing to the obsolete methods in vogue.

Peru has been a great producer in the past, but no longer figures in the returns.

Minerals containing mercury have been found in a number of localities in New South Wales, and at least two are of sufficient promise to have received Government grants for further work.†† Mercury as cinnabar has been found disseminated to the extent of 1%

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* "Comparative Statistics," compiled by the Metallgesellschaff Metallurgische gesellschaft.

† "Engineering and Mining Journal," Feb. 6th, 1909.

‡ "A Treatise on Ore Deposits." By J. A. Phillips and Henry Louis; p. 502.

§ "Mineral Industry" for 1907, p. 817.

‖ "A Treatise on Ore Deposits," p. 448.

¶ "Mineral Industry" for 1907, p. 814.

** "Mineral Industry" for 1907, p. 816.

†† "The Mineral Resources of New South Wales." By Edward F. Pittman.

through serpentine at Spring Creek, near Bingera; and also on the Clarence River, near Lionsville, distributed through serpentine-like dyke rock and on the contact of a dyke of quartz-diorite with hornblende-granite, the ore-body in the latter case being about 7 ft. thick, and carrying about ½% mercury.

Mercury also not infrequently accompanies gold in the telluride ores of Western Australia.

Cinnabar has been found near Willunga, in South Australia.

Queensland appears to be the only Australian State in which mercury ores as such have been produced in quantity. The first official record of the occurrence of mercury in north-eastern Australia was made by the Rev. W. B. Clarke, who stated in 1875 that cinnabar had been found in drift lumps and pebbles in the neighbourhood of the Clarke River.* Other reported occurrences are as follow:—

Mount Perry—a pocket of about 5 tons associated with a copper pyrites lode in granite.

Montalbion—at the Lady Jane Mine.

Mungana—7 miles south and 40 miles north of railway station.

Gilberton—5 miles north-north-east of township in alluvium.

Nebo—in Black Spring Creek.

Monsildale—on portions 13 and 22.

Kilkivan.

The Kilkivan lodes were first reported on by a geologist in 1886,† following on extensive prospecting by Mr. Sam Hester. Eight lodes were mapped, all in the valley of the Wide Bay Creek, the area within which they occur being 10 miles in length. From the descriptions given it would seem that calcite or jasper is a constant gangue here. The Queensland lode was "in places as much as seven feet thick, and the stone when dressed gave 4 or 5 per cent. of mercury. Parcels of ore from the various claims, amounting to a total of 70 tons, had been treated locally for a yield of 6,000 lbs. of mercury—an average of 3·8%." The country rock of the southernmost lode (the Old Man) is stated to be schist; at the Wolf lode it is sandstone, carbonaceous shale, and conglomerate; the Godfrey and Queensland are in much altered "sandstones and conglomerates with beds of agglomerate probably of organic origin"; and the Commotion lode is in coarse-grained granite, surrounding which is "an altered dark-coloured rock, with porphyritic crystals of felspar."‡

* "Mineral Resources of New South Wales." By Edward F. Pittman.

† "On the Geology and Mineral Resources of the Districts of Kilkivan and Black Snake." By William H. Rands, Assistant Government Geologist. Bris.: By auth.: 1886.

‡ "Alluvial Cinnabar Deposit near Kilkivan." By William H. Rands, Assistant Government Geologist. Bris: By auth.: 1892. G.S.Q. Publication No. 79.

When in the Kilkivan district in 1902 these dark-coloured rocks were found by the present writer to be associated with breccias and tuffs, and to be interstratified with Palæozoic sedimentaries. Examination under the microscope proved them to be andesitic lavas.* Opportunity was given me to visit only one of the old mines—that on mineral selection 2682; and there can be no doubt as to the intimate connection there between the andesites (or porphyrites) and the quicksilver deposits. It is interesting to note the similarity in the associated rocks at Kilkivan and the Little River, though 900 miles apart.

The output of the Kilkivan mines was sufficient for the supply of the Gympie amalgamators in the early years of the industry. Between 1874 and 1891 a total of 41 tons of mercury was produced, and the average yield of the stone treated in the last year was 5·3%. No record can be found of the later product of the mines, which have now been closed down for many years. I have heard rumours, however, that some prospecting has been going on in the district during the last few months, and that there is some likelihood of capitalists becoming interested in the work.

CONCLUSIONS.

As to the coal, the seams cropping mostly dip at high angles, and the country near their exposures is much troubled. One shaft was sunk many years ago to a depth of 90 ft., and the coal showed marked improvement in depth, but was still high in ash, perhaps owing to the adjacent faults. Analyses prove the coal to be high in fixed carbon, and therefore probably specially suitable for consumption in gas-producers. It is desirable that much further prospecting be carried out—both by shaft sinking and by diamond drilling.

With regard to the copper, nothing to warrant any further work was observed here, but few of the workings were accessible, and it is not denied that sinking and driving might result in new ore-bodies being located.

So little has been done on the mercury deposits that no conclusion can be come to as to whether they could support reduction works, though the deposits are most favourably located for fuel supplies. Extensive prospecting by trenching and sinking should be undertaken by the company. The Australian demand for mercury is quite a large one, our imports for 1906 being 77½ tons, valued at £17,139, and practically the whole of this was derived from Spanish mines.

Brisbane, 30th April, 1909.

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* Yorkey's Goldfield and the Marodian Gold and Copper Field." By Lionel C. Ball G.S.Q. Publication No. 179.

NOTES ON COAL AT MOUNT MULLIGAN, NEAR THORNBOROUGH.

NOTES ON COAL AT MOUNT MULLIGAN, NEAR THORNBOROUGH.

Mount Mulligan has several times been referred to in the publications* of the Queensland Geological Survey. Its remarkable and almost impregnable sandstone cap was first believed to be of Desert Sandstone age, but in his handbook Mr. Jack seems inclined to regard it as Carboniferous. However, the geological maps of the colony and State have until the present continued to show the plateau as Desert Sandstone (Upper Cretaceous).

During late years the discovery of a coal seam on the mountain has been announced, but nothing very definite has become known outside of the district; wherefore, the writer, being on the field early in this year in connection with gold mining, seized the occasion to pay a hurried visit to the mine, which is at the foot of the precipices,

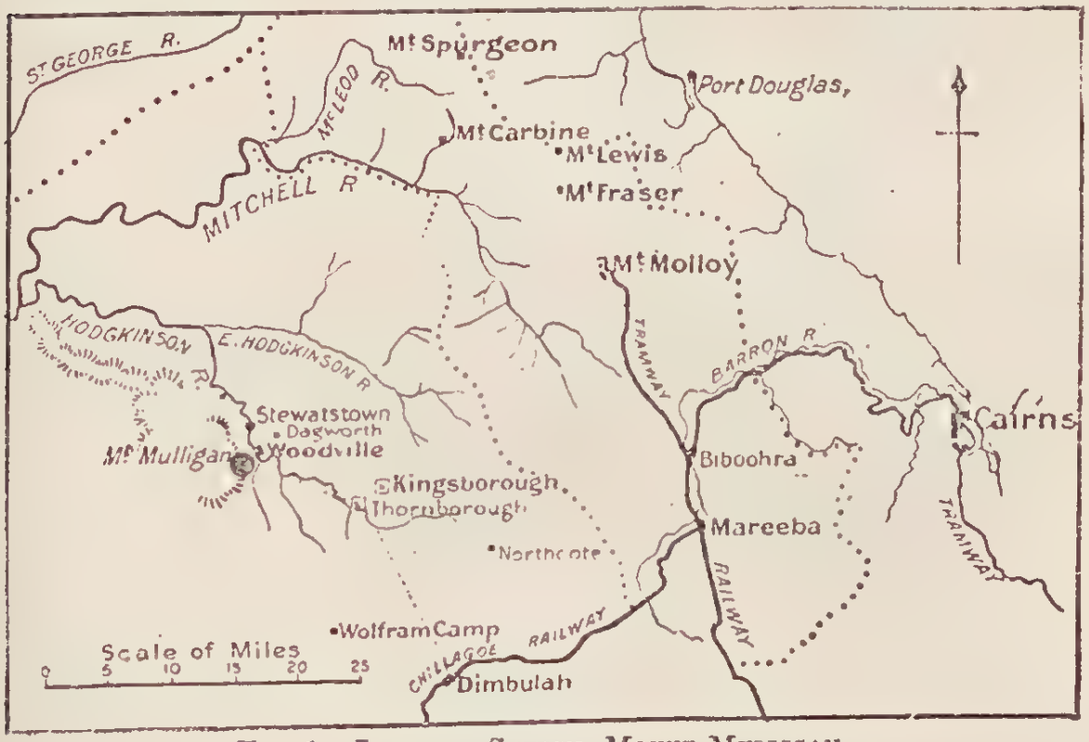

FIG. 1.—LOCALITY SKETCH, MOUNT MULLIGAN.

1¼ mile south-west of Woodville, and 10 miles west-north-west of Thornborough. The latter place is 16 miles north-north-west of Dimbula Railway Station, which is 73 miles from the port of Cairns.

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* Annual Report of the Department of Mines, Queensland, for 1904, p. 51.

"Report on the Hodgkinson Goldfield." By Robert L. Jack, Government Geologist. Bris.: By auth.: 1884. G.S.Q. Publication No. 116.

"Handbook of Queensland Geology." By Robert L. Jack, Govt. Geologist. Bris.: By auth.: 1886. G.S.Q Publication No. 51.

The adit runs south-west into the mountain, and is 242 ft. in length. Rises have been put up through the coal to the base of the overlying conglomerate at 125 ft., 175 ft., and 225 ft. from the entrance.

The shales and thin coal seams are much disturbed in the first 100 ft. of the adit, but thereafter have a dip of about 15° to the north-westwards. In the adit itself coal and shale in thin beds have been proved to be about equally abundant for 20 ft. below the main seam, which has a thickness of 7 ft., and which, in the first rise, is separated

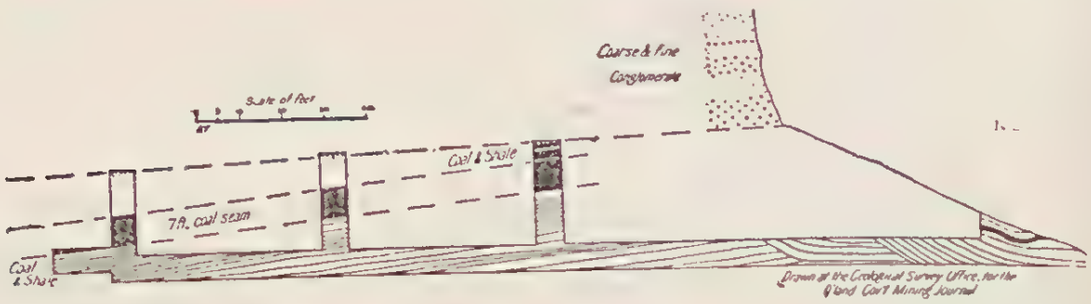

Fig. 2.—Section Along the Adit, Mount Mulligan.

by 4 ft. of coal and shale from the overlying conglomerate. This seam meets the roof of the adit at the end, and it was found possible, with some difficulty, to obtain a rough sample from the whole face in the innermost rise. In taking the sample several thin bands were omitted, but conditions were not favourable for great exactness, and it is not improbable that some dirt was included. The coal is bituminous in appearance; it has a conchoidal fracture, though it breaks readily into cubes where not crushed. Much of it is dull in lustre (presumably high in ash), and it includes small fragments of mineral charcoal. Its powder is brown. Its composition has been determined to be as below (Government Analyst):—

Proximate analysis:		Ultimate analysis:	
Moisture	1·8	Moisture	1·84
Volatile hydrocarbon ...	22 9	hydrogen	3·77
Fixed carbon	56·0	Carbon	63·47
Ash (light red)	19·3	Sulphur	0·35
		Nitrogen	1·16
	100·0	Ash	19·28
		Oxygen (by difference) ...	10·13
			100·00

The sample does not cake, coke, or intumesce.

Calorific power—Weight of water at 100° C. converted into steam (by calculation) = 10·89 lb.

The carbon hydrogen ratio being thus 17, and the fuel ratio 2·4, the coal must be classified as bituminous, but the ash is far too high to warrant the use of the coal for any but strictly local use. I was informed that a trial of 6 tons had been made on the Irvinebank tramline, but have not heard that the result of that trial has been made public. The non-caking character of the coal may be important in view of the introduction of gas-producers, and a trial should be made at Irvinebank.

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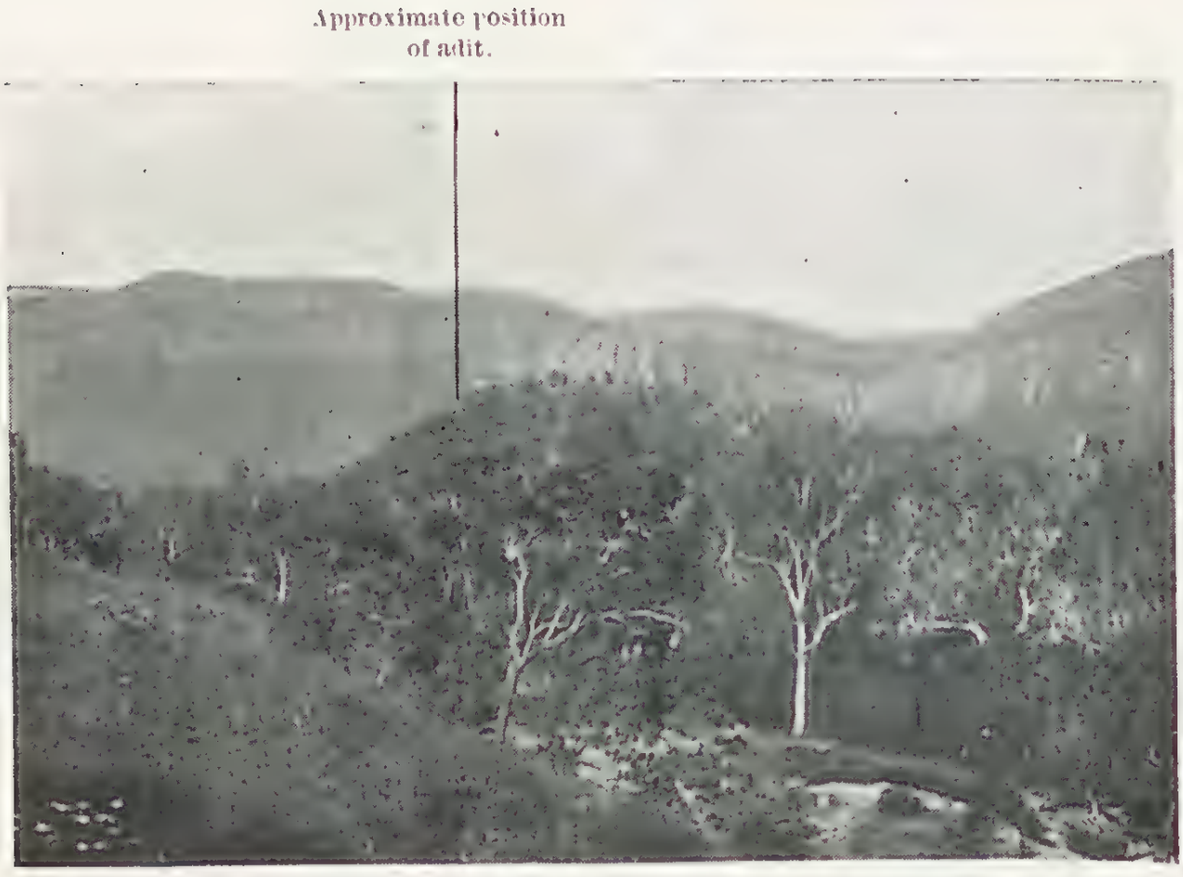

[*Photo., F. Rawson.*

FIG. 3.—MOUNT MULLIGAN, FROM WOODVILLE.

(Slate hills in middle distance, escarpment of conglomerate and sandstone overlying coal-measures in distance).

The quality of the coal was found to improve considerably as the distance from the hillside increased, and prospecting is therefore to be assisted in every possible way. The first necessity is a preliminary geological examination of the whole of Taylor's "Carboniferous" range. This might be followed by a topographical and detailed geological survey, which would probably allow of the choosing of sites for boring—perhaps the cheapest way of testing the field.

A most interesting and important result of the visit was the discovery of *Glossopteris* and *Vertebraria* in the shales associated with the coal. Glossopteris has been reported* in only a single instance from beds believed to be newer than Permo-Carboniferous in Australia. It is interesting also to note that Mr. Norman Taylor as long ago as 1872 found *Glossopteris* in the range of which Mount Mulligan is the easternmost limit.† Mr. Etheridge states that the tableland in question is, acording to Mr. Jack, a denuded fragment of the Desert Sandstone, but no evidence, palæontological or other, is offered in support of this statement. The strata of the coal measures have nothing in common with those of undoubted Desert Sandstone age, such as those in the vicinity of Maryborough, which are richly fossiliferous. I am, therefore, of opinion that the coal measures are to be assigned to the Permo-Carboniferous system.

The section given in Fig. 2 shows a slight unconformity between the coal measures and the overlying conglomerates, and it is quite likely that the latter may have to be referred to the Mesozoic, but it would, without fossil evidence, be unwise to venture an opinion as to which epoch, in view of the late changes found necessary in the nomenclature of similar rocks in the Cooktown district.‡

Tilted and highly altered sedimentaries, especially micaceous sandstones, are found 30 ft. below the level of the adit, thus limiting the thickness of proved coal measures to about 50 ft. It is, however, not improbable that the thickness of coal measures may increase to the westwards, filling an old valley beneath Mount Mulligan.

At the beginning of the year there were four coal prospecting areas in force, the adit being in the south-eastern part of C.P.A. No. 12, held by W. J. W. Richards. The work here was carried out some months previously on behalf of the Irvinebank Company, and to Mr. C. Arbouin, of that company, I am indebted for his assistance in getting to the mine.

Brisbane, 5th May, 1909.

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* For remarks on the occurrence see "Geology of Queensland." By Jack and Etheridge, pp. 518 and 558. The locality is the Cape River Goldfield.

† *Op. cit.*, p. 559.

‡ See "Geological Reconnaissance of Part of the Cooktown Coalfield." By Lionel C. Ball. Q.G.M.J., Apr., 1909, p. 182.

THE KING OF THE RANGES TIN MINE, WATSONVILLE.

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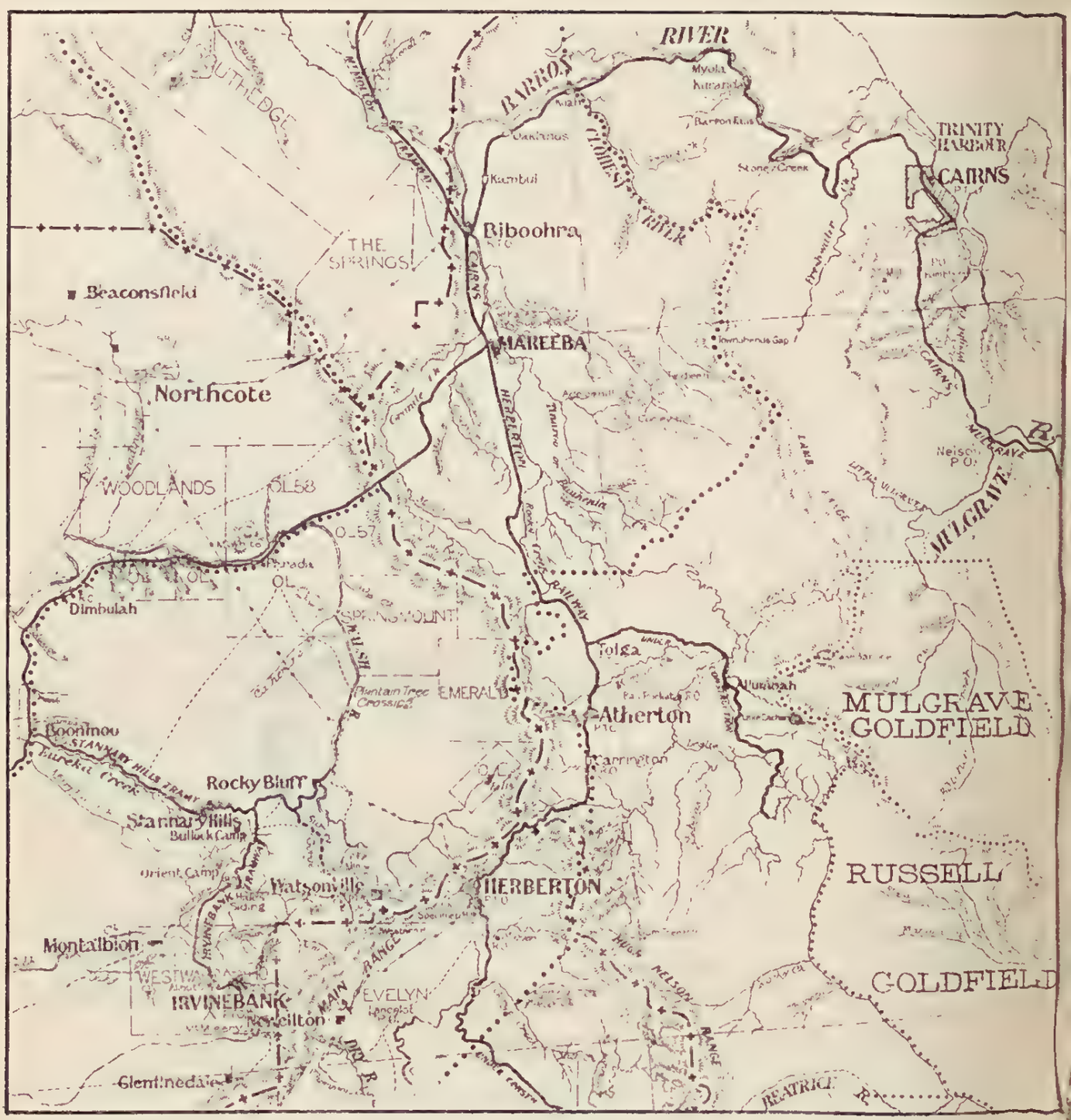

Locality Plan.

THE KING OF THE RANGES TIN MINE, WATSONVILLE.

Introduction.

The King of the Ranges, a mineral lease (No. 1279) of 19 acres, is located on the steep spur overlooking the township of Watsonville, in the Walsh and Tinaroo Mineral Field.

My instructions were to make a report on the mine from a geological, rather than from an economic, point of view. When the mine was visited, early in January of this year, the manager was on the spot, but had only one man underground; the examination was made under the disadvantage of no plans being available, a considerable portion of my time being taken up in connecting the workings and making plans—time that could better have been spent in looking into the geology of the neighbourhood. The absence of any definite knowledge of the assay value of the faces exposed is a standing hindrance to the profitable exploitation of the ore-bodies.

Workings.

The manager (Mr. Kennedy) informed me that over £1,600 has been spent by his company on development alone, no machinery having been erected here.

The main workings comprise two open cuts (called the Main and Big Cut), a main shaft, and two adits, but besides there are eight other cuts and six shafts, none of any great depth. The top adit runs directly to the main shaft, which is also connected with the bottom adit by an inclined winze. The latest important work of the company was the driving of the latter adit under the shaft to drain the old workings, but a beginning has been made to crosscut south from the bottom of the underlie shaft.

I am of opinion, as will be shown below, that the work done warrants the carrying out of the following additional exploratory work:—Driving eastward from the prospecting drive (60 ft. above the bottom adit); the continuation of the bottom adit to strike the main joint, along which a drive will have to be carried to the east; and, besides this, the 126-ft. level should be extended eastwards to test the country beyond the dyke.

Whether this work is done or not, it would certainly be very unwise to close down the mine without previously sampling it throughout—a work of great labour, to be very carefully carried out. It may not be necessary to send many of the samples to the assayer, but most of them should be crushed and panned-off on the mine, the approximate results so obtainable being quite sufficient for the

guidance of the management. In order to get a true estimate of the value of the faces the samples should be taken at regular intervals of a few feet, and should consist not of single specimens but of a great number of chips from over the whole height sampled. If very bulky, the samples after being broken down might be halved and quartered prior to removal.

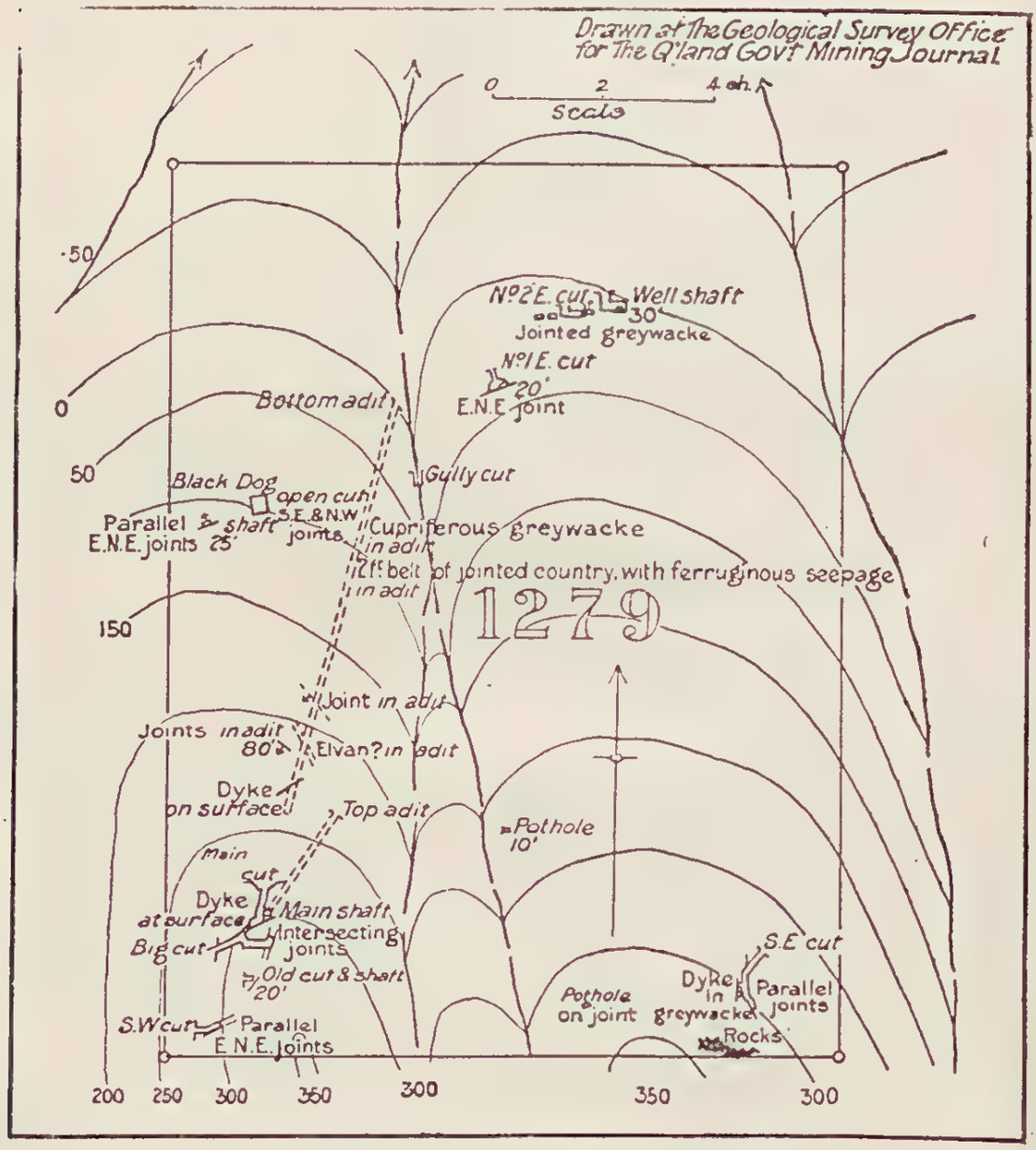

FIG. 1.—SKETCH PLAN OF THE LEASE.

By Lionel C. Ball, B.E.

As time permits some attention should also be given to the various old workings on the lease (described below), for, even if no payable ore is exposed below them, it is quite possible that new bunches will be found within short distances, either horizontally or vertically, along the joints from which the ore was taken in the early days.

Black Dog.—It is said that 14 tons of tinstone have been taken from the Black Dog workings, which include an open cut and a shaft.

The sloping cut, 20 ft. (east and west) by 20 ft. (north and south) and 1 to 4 ft. deep, is three or four chains south-west of the mouth of the adit. There is no sign of lode here, the tin stone occurring simply on the north-west and south-east joints in ferruginous greywacke, and these do not appear to have any great extent. This is probably the belt struck in the bottom adit, 150 ft. from its mouth.

About one chain west-south-west of the cut is a shaft, 25 ft. deep. In this there is a pair of well-defined parallel joints, running west-south-west and dipping 1 in 6 northwards. The width of the lode—that is, of the country between the joints—is 2 ft. 6 in.; and in this tinstone has been found in three short pipes, not more than 4 ft. in length and 5 ft. apart.

Well Shaft.—This, one of the oldest workings, is located in the north-eastern part of the lease, on about the same level as the mouth of the adit. It has a total depth of 30 ft., and about it has been excavated an open cut 35 ft. in length and up to 20 ft. in width. In this cut is exposed a much-jointed greywacke, from which bunches of tinstone have been taken. The ore raised from the shaft and still at grass is a granular quartz, in which are scattered grains of wolfram. The last blocks brought to the surface are of a chloritic rock containing scattered dodecahedral crystals of pink garnet. There is said to be no tinstone at the bottom of the shaft.

No. 2 East Cut.—This is two-thirds of a chain west of the Well shaft. At the eastern end is a filled-in shaft, from which the open cut extends 30 ft. to the west, with two short approaches from the north. The greywacke is here much jointed, and presumably fair tinstone was found on the surface.

No. 1 East Cut.—This cut lies one and a-half chains east-north-east of the mouth of the adit and 20 ft. above it. The cut is 20 ft. in length, with an approach 35 ft. long, and at the eastern end is 20 ft. deep. It has been opened along an east-north-east joint, from which a bunch of ferruginous ore has been removed. A lenticular bunch of gossan 18 in. wide, which is probably an oxidised and leached mispickel, is still left in the deepest part of the cut.

South-west Open-cut.—This is only three-quarters of a chain from the south-western corner of the lease. It runs east-north-east along a pair of joints (five feet apart) for about 30 ft., with a width of 7 ft., and from the end a prospecting drive has been carried 20 ft. further. Adjacent to the joints the greywacke is much chloritised, and a bunch of rich tin-ore was removed from the end of the cut. There is probably little or no tinstone in the face, though wolfram, chalcopyrite, chlorite, and quartz are showing. The drive should be continued as a prospect.

South-east Open-cut.—This isolated cut is within 2 chains of the south-eastern corner of the lease. It follows a main joint for 40 ft. to the south, and then for 20 ft. to the south-south-east. The exact

strike of the joint is north 10 degrees west, the dip being about 80 degrees westwards. Bunches of ore have been removed from both sides of this joint. Some 12 ft. to the west of the joint a thin porphyry dyke runs north-north-westwards, and adjacent to it the jointed country is much iron-stained. The stanniferous nature of this country is due to the intersection of joints—one, running north-north-eastwards and dipping 85 degrees to the east-south-east, having been followed by the 30-ft. approach.

Big Open-cut.—The Big Cut is ½ chain north of the old cut and shaft, and 12 ft. above them. The main portion of the cut extends in an east-north-easterly direction for 30 ft., with an average width of 6 ft., and from it arms extend north-north-east and north-north-west, the latter opening into a 30-ft. approach from the west-south-west. This has been continued 12 ft. to the main open cut, past a shaft 25 ft. in depth. The depth of the cut gradually increases from 6 ft. on the west to 30 ft. on the east. The approach follows the southern joint of the shaft cut, and the main portion of the big cut is bounded on the south by another joint, besides which are three others at the eastern end of the cut. The tin occurred here on the main east-north-easterly joints, as far as the cross joints, along which it was followed about 10 ft. Only kaolinised and formerly pyritous iron-stained greywacke can now be seen in the cut.

Main Open-cut.—This cut, which is 20 ft. long, 10 ft. wide, and has an approach from the north 30 ft. in length, was opened subsequently to the sinking of the main shaft, from which the ore was found to extend along a strong joint for 20 ft. to the west-south-west. Ore has been stoped out beneath the open-cut for 60 ft. on each side of the shaft. The country-rock here is greywacke, slightly mineralised along the numerous joints. In the approach to the cut can be seen the cap of a dark dyke, proved below in the underlie shaft, and probably the same as that met to the west of the mouth of the top adit.

Top Adit.—This is about 220 ft. above the main adit. It has a length of 141 ft., and runs north 216 degrees east to the bottom of the vertical portion of the main shaft, from which it has been continued to the south-west, being now open for 50 ft. Drives have been opened along it for 18 ft. west and 47 ft. east, and two other roads run 10 ft. east and 15 ft. south.

The workings here expose a main joint running east 10 degrees south, and four cross joints on its southern side, varying in direction between north and north-west. The best ore-body, extending along the main joint, in one place to the north-north-east striking dyke elsewhere referred to, has been underhand stoped for 80 ft. in the eastern part, and has been sunk on by the main shaft for 178 ft.

Winze and Stope.—A winze has been sunk for 80 ft. from the top adit, the stope alongside it having a length of 25 ft., and a width

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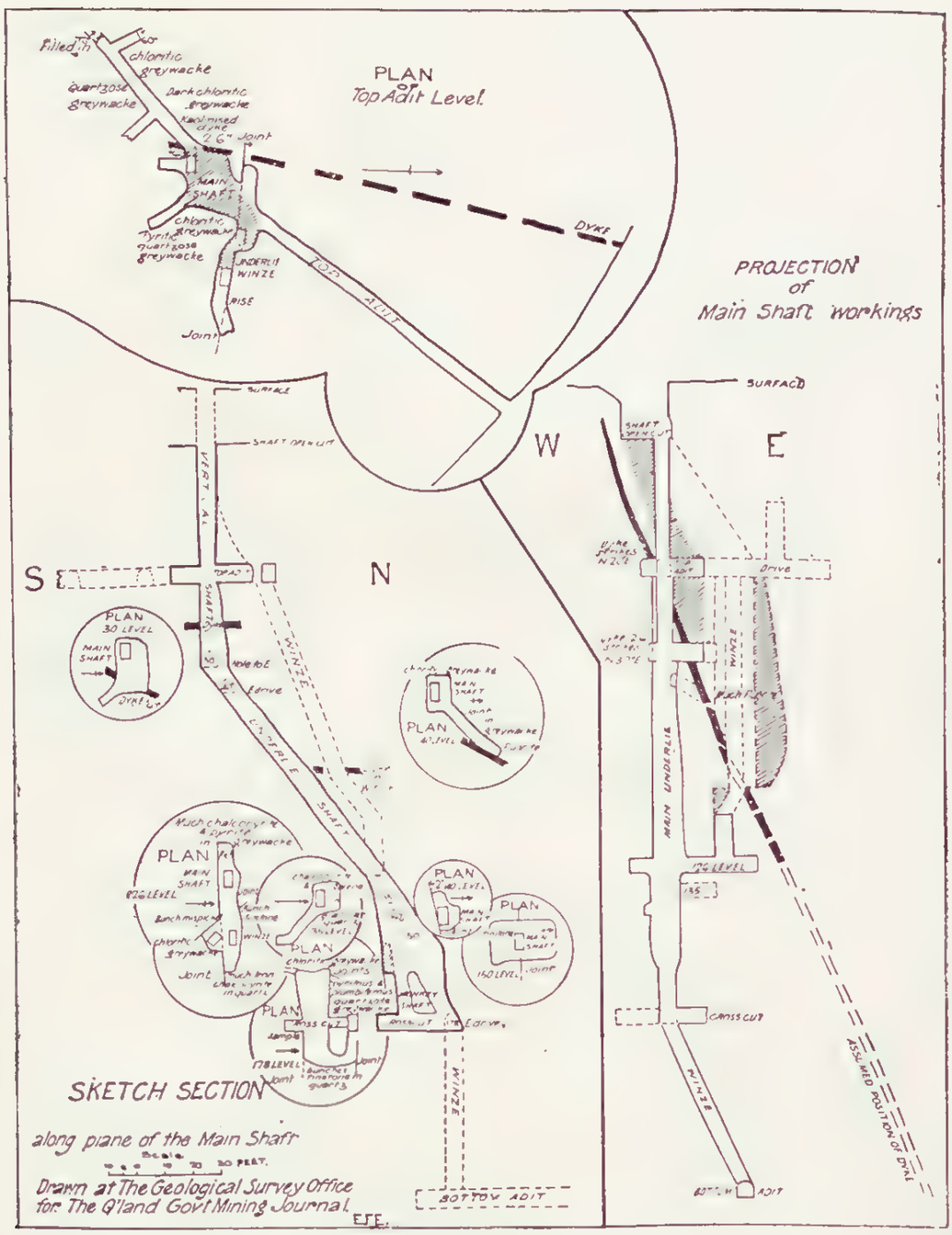

FIG. 2.—PLANS OF THE WORKINGS.

By Lionel C. Ball, B.E.

of 12 ft. It has been followed down to the dyke, which was cut through and connection made with the 126-ft. level east from the shaft. The stope is just on the intersection of two strong joints, one running north 55 degrees west and one followed by the stope east 20 degrees north. At the bottom of the stope the dyke, which has come down from the main underlie shaft just below the top adit, has invaded both of these joints, and makes a peculiar rectangular bend. As depth is attained, the stope gradually closes up to the main joint, and Mr. Kennedy therefore proposes to drive beneath it, and there is some probability of the ore body continuing here.

Underlie Shaft.—The underlie shaft begins from the bottom of the vertical shaft 30 ft. beneath the top adit. For 96 ft. it has an inclination of 53 degrees to the north, and then for 60 ft. an inclination of 64 degrees to the north. At the 30-ft. level a stope has been excavated round the shaft 20 ft. in length and 10 ft. in width, and across the eastern part of this the dyke cuts north 30 degrees east, its thickness here being 2 ft. 6 in. On the 40-ft. level there is a sloping drive to the north-east for 30 ft. along an irregular joint coming away from the dyke cut in the end. A bunch of "soapy spar" was met near the end of this drive, in chloritic greywacke. Similar bunches of this peculiar rock were met in the winze and stope, also adjacent to the dyke.

The 126-ft. level is the most extensive, having a total length of 40 ft. In the face 10 ft. west of the shaft much chalcopyrite occurs in the greywacke, but between the face and the shaft a rich bunch of tinstone is said to have occurred. The level runs along the main joint, and about 10 ft. east of the shaft is crossed by another strong north-west striking joint, adjacent to which, on one side of the level, a rich bunch of tin ore was found, and, on the other side of the level, a patch of arsenical sulphide; and down which a winze was carried from the stope already described. In the eastern face of the level some chalcopyrite is visible in the quartz, which at the same time is very ferruginous. (See Fig. 3.) This level should be extended to and through the dyke, for the purpose of proving if the ore body worked in the stope above has cut out or not.

At the 135-ft. level the stope on the main underlie is 10 ft. in diameter, and short drives have been carried 12 ft. to the south-east and 5 ft. to the south. On the roof of the stope (not the wall which is said to be many feet to the north) both chalcopyrite and galena occur in granular quartz. A short drive to the west at the 140-ft. level exposes 3 ft. of greywacke partly replaced by galena, chalcopyrite, mispickel, &c., apparently the same body as that seen in the west side above. The ore, however, is not rich in either lead or copper, even in the bunches, and no bulk of pay ore is showing. This is on the northern side of a joint running north-north-east and dipping 72 degrees to the north, the tin ore found in the stope being under—that is, south of—the joint.

At the 150-ft. level the miners have broken 10 ft. into the foot-wall greisen, the east and west joint being in the middle of the stope, which here is 25 ft. wide but only 15 ft. long.

Beneath the 160-ft. level the main underlie contracts in size, and a monkey shaft has been sunk from the southern side of the stope. This is wholly in lode material—a quartzoze greywacke carrying chalcopyrite, galena, and tinstone. These are, however, connected at the 178-ft. level by a crosscut running 23 ft. south from the underlie. Drives have also been carried for 10 ft. east of the underlie and for 12 ft. east and 15 ft. west of the monkey shaft on the last level. Very good tinstone is said to have been found in the eastern faces, where now only quartz carrying chalcopyrite is to be seen. In the western level lead is present as well as copper, and the greywacke is much chloritised. A surface sample was taken (at the manager's request) from the mullock thrown back from the last 6 ft. of crosscutting, the stone proving to be a granular quartzite with chlorite stains on the joints and carrying a very fair percentage of chalcopyrite. The sample has been assayed as follows (Government Analyst):—

Gold	Nil
Silver	1 oz. 9 dwt. per ton.
Copper	2·7%
Tin	Trace
Tungstic acid	Nil
Fluorine	Present in small quantity.

This is exceedingly disappointing as far as the tin is concerned, but the comparatively large quantity of copper present is a not unpleasing feature, and, in future prospecting for tin, the fact that there is here possibly a large low-grade copper deposit should not be lost sight of.

FIG. 3.—TIN-ORE, 125-FT. LEVEL, KING OF THE RANGES.

Quartz ...	*White (original grains partly surrounded with chalcopyrite)*
Chalcopyrite	*Black*
Wolfram ...	*Hatched*
Tinstone ...	*Stippled.*

Bottom Winze.—This winze follows for 62 ft. a head, running north 15 degrees east and dipping 65 degrees to the eastwards, from the bottom of the underlie to the bottom adit 10 ft. from the inner end.

Lower Adit.—This adit runs south 15 degrees west and has a total length of 495 ft. It is 6 ft. high and 5 ft. wide, and the total cost of driving was only £3 2s. 6d. per foot, including iron rails—very cheap work indeed, even though no timbering was required. Two bunches of cupriferous gossan, 12 in. and 6 in. in diameter, occur on east and west joints in the greywacke about 150 ft. from the mouth. At 200 ft. from the mouth there is a 2-ft. belt of jointed country, from which strongly ferruginous water is seeping. A joint, met at 132 ft. from the end of the adit, dips 45 degrees to the south-west, and is stated to have drained the shaft, being probably connected with another cross-joint. At 90 ft. from the end of the adit 11 ft. of elvan was passed through. The greywacke in the face of the tunnel is much coarser than usual, and the last foot contains much mispickel, while the water seeping from the face is very ferruginous. These are all indications that the adit is approaching an ore body, and, when the prospecting advised has been carried out in the upper levels, the adit should be continued to the joint, along which a drive should be carried to and beyond the dyke, in the vicinity of which a carbona of tinstone may possibly be found.

Geology.

Country Rock.—On Mr. Jack's map No. 2 of the Western district accompanying his report* on the Tin Mines of Herberton, published in 1883, the whole of this lease is shown within the area marked "Porphyry," though a narrow slip of slates and greywacke is shown at the foot of the range separating it from the Watsonville granite country. Mr. Skertchly in the geological maps accompanying his reports on the Deep (Tin) Lead, Herberton† and the Tin Mines of Watsonville‡ adheres to this mapping. Mr. Cameron, however, in his sketch map§ of the Walsh and Tinaroo Mineral-field, indicated this country as granite and porphyry.

The country-rock, of which the upper part of the King of the Ranges ridge is composed, has thus been variably described as granite, porphyry, and greywacke; and, without examination under the microscope—a section cutter not being available—absolute certainty cannot be attained, but the rock as a rule more nearly agrees with greywacke than porphyry, except in a few places where there are undoubted quartz and felspar phenocrysts, as in the bottom adit, where much of the rock bears a strong resemblance to porphyry, and where it would be

* G.S.Q. Publication No. 13.
† G.S.Q. Publication No. 115.
‡ G.S.Q. Publication No. 119.
§ Q.S.Q. Publication No. 187.

difficult to define the dividing line between the two rocks. It, however, has no resemblance to granite. Near the surface the rock is light in colour, having a very fine-grained, golden, micaceous or chloritic base, in which are scattered irregular quartz grains from 1/32 to ¼ in. in diameter and a few decomposed ferro-magnesian (?) laths. At depths it becomes darker, scattered quartz grains occurring in a chloritic base.

Joints.—Great numbers of roughly parallel and intersecting joints have been produced in these rocks, the main ones or master-joints striking east-north-east and dipping to the north-north-west. These are intersected by two other series, one striking north and south and the other north-east, and it is only in the vicinity of the intersections that tin ore has been found.

Tinstone has been taken from all the workings, always occurring along joints and near intersections. It has, however, not been proved to continue payably to a greater depth than 25 ft. except in the main shaft, where worked to over 200 ft. from the surface, and where the water trouble caused cessation of work. Operations have of late years been concentrated here.

Dykes.—Three small dykes were noticed, two of them on north and south joints, and one on an east-north-east joint. The last, lying to the west of the mouth of the top adit, is most probably connected with that exposed in the shaft. It is 18 in. in thickness, and is almost completely kaolinised, but the outlines of a few crystals of felspar can still be distinguished.

Conditions have been somewhat complicated at the mouth of the main shaft by the intrusion of a dyke of diabase (?), which has been exposed in the approach to the main open-cut, in the top adit, and at 30 and 80 ft. below that level. At the surface tinstone has been found only to the east of this dyke; between the top adit and 80 ft. below, there are workings on both sides of the dyke; but below that level the ground along the dyke remains unprospected. In my opinion the dyke is younger than the ore deposits, yet further prospecting should be carried out along it, for it has presumably welled up a joint-plane, the country adjacent to which is most likely to have been mineralised by the stanniferous solutions.

There is thus good reason for the manager's desire to continue the 126-ft. level to the eastwards to intersect the dyke (probably within 10 ft.) and to prospect the ground beyond.

Ore Bodies.—Though the joints, occasionally and for short distances, form walls for the ore-bodies, the latter are, on the whole, without defined or regular boundaries, as is to be expected from the nature of their genesis.

As Mr. Skertchly hinted in 1897, "The tin is one of the last products of the series of changes which have given rise to the dykes."

It may be taken for granted* that the tin has been derived by magmatic extraction from the deep-seated granite, and was able to ascend through the joints in the overlying rock as a gaseous fluoride, and to further pass some distance into the adjacent rock, where decomposition and precipitation took place. The abundant quartz of the ore-bodies had a similar origin, and the accompanying wolfram, arsenical pyrites, and chalcopyrite have also been satisfactorily accounted for in similar deposits elsewhere. The proof of the action of flourine as a carrier, is afforded by the fluorspar in the ore-body, the result of action of the nascent hydrofluoric acid (produced by the action of water on tin or silicon fluoride) on the lime of the country rock. Blende and galena again are believed to have been derived with tinstone from a deep-seated granite magma in the Saxon Erzgebirge, but commonly occur at a much higher level than the tinstone. These generalisations may be said to be indicative of the tin ore improving in quantity at a depth on the King of the Ranges, but against them it must be mentioned that special conditions may have obtained here preventing precipitation at greater depths, precipitants may have been absent, and open joints may not have been available. It is also not to be expected that such very rich tinstone will be found in depth as was got near the surface, for it is coming to be believed by trained observers in the Walsh and Tinaroo district that there has been a similar secondary enrichment of the upper parts of tin lodes as of gold lodes, by dissolution and reprecipitation.

It is difficult to give any true idea of the exact size of the ore-bodies; one can only refer to the size of the stopes. The stope under the open-cut is said to be 12 ft. across, and to have a length of 20 ft.; on the top adit level it has a total length of 40 ft., but below that the ore has been taken out in two stopes—viz., that known as "the winze," which is 25 ft. long and 12 ft. wide, and that surrounding the shaft, which has the following dimensions:—At the 30-ft. level (below the top adit), 15 ft. long and 10 ft. wide; at the 126-ft. level, 8 ft. in diameter; at the 135-ft. level, 10 ft. in diameter, and at the 150-ft. level, 15 ft. long and 25 ft. wide. To judge from the workings, therefore, the ore bodies have the form of pipes aligned along a joint plane in the vicinity of a dyke.

The Ore.—The ore, as elsewhere mentioned, is simply altered country rock. On the top adit level, and generally where much tinstone has been found, it has been "chloritised," but in other places, especially where the copper percentage is high, intense silicification has taken place, the rock appearing then as a granular quartzite with green-stained joints.

Very rich ore was raised from the upper workings, but only those constantly at work in the mine are able to distinguish the tinstone in that coming from the lower levels. An examination of the

* See the works of De Beaumont, Daubrée, and Vogt.

tipped waste reveals the presence of considerable metallic contents, wolfram occurring associated with chalcopyrite, galena, and cassiterite in quartz. Arsenical pyrites and fluorite, the latter chiefly on joints, were also noticed. Much pyrite was observed with chalcopyrite in greywacke on the 126-ft. level west, there having been a sudden change here from cassiterite to sulphides. The same ore can be seen again on the 140-ft. level west, where greywacke is replaced over a width of 3 ft. by galena, chalcopyrite and mispickel. The sulphides here, however, are separted from the tinstone by a joint-plane. Very good bunches of tinstone are said to have been got on the 178-ft. level, but the stone now showing appears macroscopically to be a low-grade siliceous copper ore rather than a tin ore.

Bibliography.

"The Tin Mines of Herberton, Western and Thompson's Creek Districts," &c. By Robert L. Jack, Government Geologist, Brisbane. By authority. 1883. G.S.Q. Publication No. 13.

"The workings here have been hitherto mainly open-cast following two slips or lodes . . . and below a band of white unaltered slate striking east and west is seen at the mouth of the opencast in contact with the poryhyry of the country. . . . On the upper or northern slip a 50-ft. shaft has been sunk." Later on Mr. Jack says: "A drive has been started to cut the deposit where the tin ore was lost on a very fine, hard, black diorite running east-north-east, and containing arsenical pyrites." This presumably refers to the top adit and the main shaft.

"From the lower levels there are about 150 tons of 30 per cent. stone in small chips," and from the surface of the main workings came 138 tons, carrying 15 to 50 per cent. tinstone (the details given of these are not very intelligible); besides which "south of the main workings about 5 tons of splendid 'black ore' with a little quartz were obtained at 15 ft. from the surface in a cutting."

"Tin Mines of Watsonville," by S. B. J. Skertchly, Assistant Government Geologist. Brisbane. By authority. 1897. G.S.Q. Publication No. 119.

The King of the Ranges is not described, but a minute description of the surrounding district and mines appears here. Mr. Skertchly shows that the North Australian group is in a "series of rocks consisting of sandstones, greywackes, and shales belonging to the Gympie (Permo Carboniferous or Devonian) series. These beds in this district are intimately associated with granite which crops out in all the headlands to the north, with porphyries, which occur as 'masifs' or large bodies, or as dykes or elvans, and with dykes of basic rock."

8th March, 1909.

MAP OF PART OF THE ANNAN RIVER TIN FIELD.

MAP OF PART OF THE ANNAN RIVER TIN FIELD.

It was intended that the attached map should accompany a report on the Collingwood lode, but it is thought advisable in the interest of prospectors to issue it in this bulletin as that report may not appear for some time.

A geological map of the district was published by Mr. Jack* in 1891, and a topographical map of the field appeared with Mr. Cameron's report in 1907.†

The Annan River is shown on a locality plan on page 21 of this bulletin and Rossville public house and school, near the centre of the area mapped, are located 19 miles south-by-east from Cooktown.

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* Tin Mines near Cooktown, Cook District, R.L.J., 1891. G.S.Q. No. 66.

† Annan River Tin Field, Cooktown District, W.E.C., 1907. G.S.Q. No. 210.

By Authority: ANTHONY JAMES CUMMING, Government Printer, Brisbane.

GEOLOGICAL
SKETCH MAP
OF THE NORTHERN PART OF THE
ANNAN RIVER TINFIELD
BY
LIONEL C. BALL B.E.
Assistant Govt Geologist
1909
40 20 0 40 80 120 160
Scale of Chains
PACIFIC
OCEAN
ANNAN
RIVER
Mungumby Creek
Wallaby Creek
Carrons Creek
Slaty Ck
Adams Gully
Mt Tolbert
Mt Hartley
Mt Walker
Mt Shipton
Mt Finlayson
Mt Bolen
Mt Thomas
Mt Amos
Mt Browning
The Big Scrub
The Lindsay D.C.
The Groper D.C.
The Platypus D.C.
Bowles Claim
Grass Tree
Cascade
Parrot Ck
Waterfall Ck
Rileys Beach
Nunns
Young's House
Archibald's House
Phoenician
Rossville P.H.
Blue Spec D.C.
Three Mile Workings
Sawyers Claim
Morning Star
Bowerbird
Adelaide
Johnsons Claim
Table Land
Precipitous Range
Scrub Range
Palm scrub
Cedar Bay
Granite reported
Patches of Slate
Mountainous Country
Black sand in creeks
Slate bottom reported over considerable area where Granite shows at surface
Very light coloured Granite chiefly lathed Orthoclase semi idiomorphic Quartz & sparse Biotite
INDEX.
B Post-Tertiary basalt.
Slates of undetermined age
G Granite

23 NOV 1933
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Queensland.

DEPARTMENT OF MINES.

Queensland Geological Survey.

(B. DUNSTAN, GOVERNMENT GEOLOGIST.)

PUBLICATION No. 223.

The Starcke Goldfield.

WITH TWO MAPS AND THIRTEEN FIGURES.

BY

LIONEL C. BALL, B.E.,

ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE:

BY AUTHORITY: ANTHONY JAMES CUMMING, GOVERNMENT PRINTER.

1909.

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VICTORIA·
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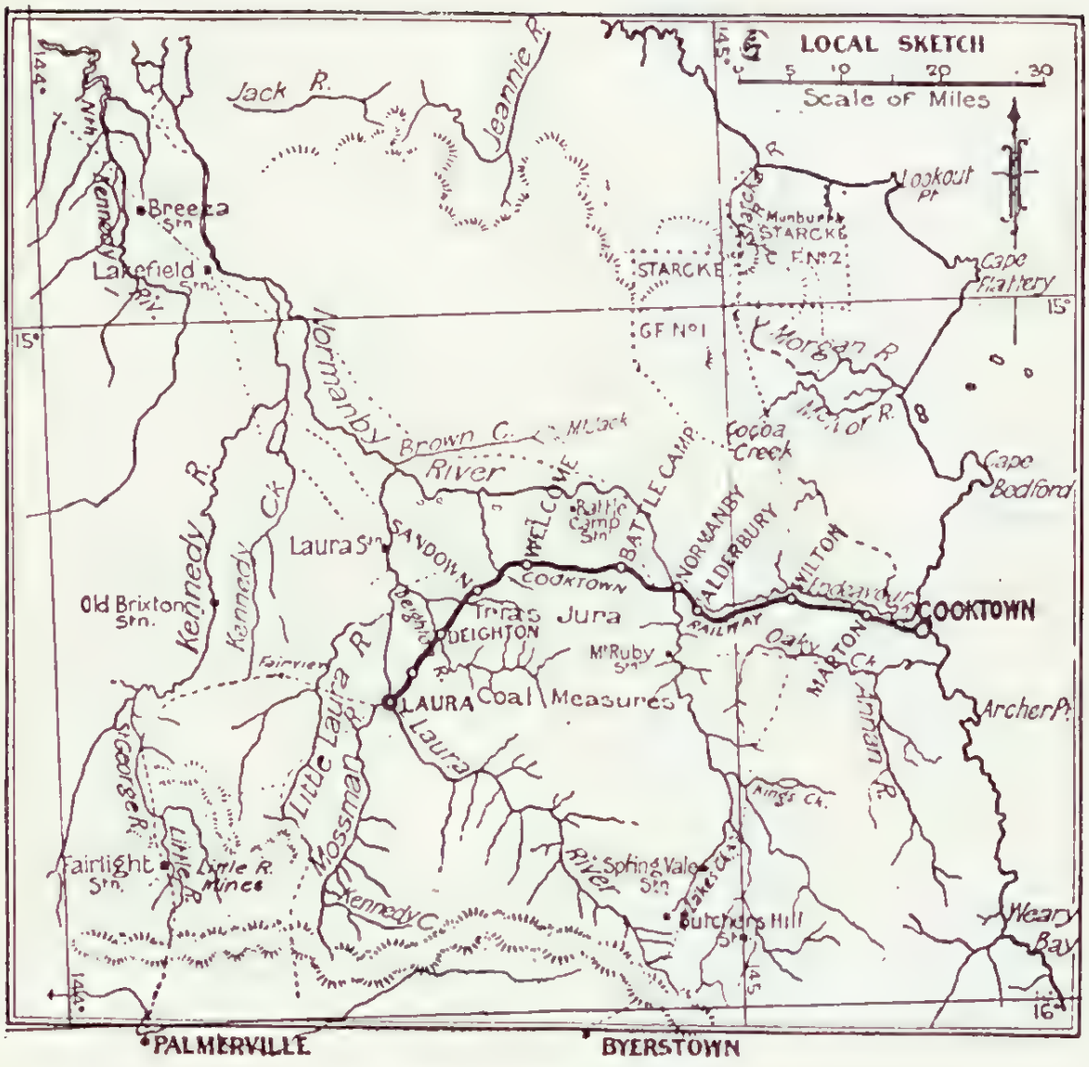

Map 1. Locality Plan.

THE STARCKE GOLDFIELD.

PRELIMINARY.

An account (1) of the more important workings on the Starcke was published by Mr. Cameron, of this Survey, in 1906; and the desire of the people of the North for a more extended report is the reason for the length and detail of the following descriptions of an almost abandoned field.

While in Cooktown I was privileged to glance through the MS. of an essay by Mr. Dick, on the mineral wealth of the district. This had taken a prize at the local show and the committee of that institution had thought of publishing it in pamphlet form. It contains much of interest as to the early days of the fields, but is considerably marred by frequent personal reflections on other workers. Mr. Dick's estimate of the output of certain of the Starcke mines is much greater than those of the Warden.

My examination was made under the great disadvantage of there being so few mines working that it was difficult to form an opinion of the nature of the reefs below ground, while the payable portions at the surface had long been removed. Without the assistance of Messrs. Stuckey and W. Webb not a fraction of the workings described below could have been located. The great heat experienced during the latter part of the survey told against reliable and detailed work, which had in any case to be hurried owing to the scarcity of horsefeed in the district. Mr. R. Macdonald, the junior assistant, accompanied me in the field.

Geography.

Starcke Goldfield No. 1 was proclaimed in 1895 to have an area of 210 square miles. It extends from the head of the McIvor River on the south to the lower part of the Starcke River on the north. Starcke Goldfield No 2, proclaimed three years later, has an area of 222 square miles, and lies on the north-east of the No. 1 field. The only

(1) Some Goldfields of the Cape York Peninsula. By Walter E. Cameron, B.A., Assistant Government Geologist. Bris.: By Auth. 1907. (G.S.Q. Publication No. 209.)

mines on the former are those of Cocoa Creek, the field having been proclaimed prior to the correct location of the Starcke workings, now included in the latter.

Munburra, the surveyed township site, where the post office, store, and battery are situated, is on the No. 2 Goldfield, 43 miles north-north-west from Cooktown, but the distances by road and track are 60 miles or 75 miles (according as the Cocoa Creek or McIvor route is taken). It is possible to drive to the McIvor, but beyond that there is only a bridle track. Stores are generally shipped from Cooktown to the mouth of the Starcke River, and are thence taken by dray to Munburra, which is 10 miles distant from the landing.

Topography.

The topography of this area is much diversified. The Starcke Valley occupies the site of an old mountain tract, of which the coast range hills are the stumps. It has a width at Munburra of between 4 and 5 miles. To the west of the Starcke River is a sandstone-capped plateau, which presents well-marked escarpments to the valley and has a gentle westward slope to the Normanby River. The mountains at the head of the Starcke, however, have more often the form of "mesas," which bear witness to the former extension of the tableland in this direction. The streams have cut rapidly and deeply into the underlying slates, and the hills and ridges are consequently very precipitous. The divide between the river and the sea on the north-east has lost almost the last remnant of its former sandstone cap, and exhibits the characteristically rounded and conical forms of slate country.

Munburra has an elevation of about 150 ft. above sea level, the Coast Range rises to 900 ft., and the western plateau to 1,100 ft.

History.

Gold was discovered in the valley of the Starcke by two prospectors, Cairns and Bowden, at the end of 1890. The alluvial in the gullies at the head of Diggings Creek supported some 200 men for a period of 6 months and a smaller number for 5 years, but the find was never officially reported as payable.

Alluvial gold was discovered by Webb and party on the lower part of the valley in 1896, and at once reported to the Warden. A small "rush" resulted and, owing to the disappointing returns, one of the prospectors had a narrow escape from lynching by the angry miners. The total recorded return of alluvial from Munburra, the name given to this locality, is only 639 oz.

Although the alluvial rush here was a fiasco, it led within a remarkably short time to the discovery of most of the reefs now known on the field, the Last Hit being the first find of importance. A small

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Photo., L.C.B.

FIG. 1.—THE VALLEY OF THE STARCKE, SHOWING ESCARPMENTS OF THE TRIAS-JURA PLATEAU.
(Looking over the Last Hit.)

battery was erected on the field in 1898, and a second in the following year. The miners quickly worked out the pay shoots above water level, and in 1902 the first pump was installed (on the Boomerang).

Owing to no reserves having been made it became evident as early as 1901 that little more could be done by the individual miner, and attempts were made to interest outside capitalists in the field. A small local company carried on operations on the Boomerang claim during 1901, and in the following year gave place to another, known as the Queen Alexandra. In 1907 the Starcke United Gold Mining Company was floated, and took over most of the western holdings. The capital of the first companies was too small, and the last has now had to cease operations, chiefly because of frequent changes of management and the expense of mining and treatment. The latest reports from the mine, which is the deepest on the field, are not as favourable as could be desired, but it does not appear to have been taken into consideration that the shaft is off the gold-bearing shoot, which should be picked up by driving along the reef.

At the end of 1908 there were 35 miners on the field.

Treatment.

In the early days of the field there were two batteries in the vicinity of Munburra, but for many years only one, Mr. Stuckey's, has been available (the other having been removed to the Hamilton Goldfield). That is of an extremely light and out of date type, with two pairs of stampers, each pair in a separate mortar box. The amount of stone crushed per shift of 8 hours is only 4¼ cwt. per stamp. The stampers weigh only 5 cwt., and have a 9-in. drop; and the boxes are hand fed. The silvered plates below the battery have a total length of 4½ ft. Beyond this there are no appliances for further treatment of the sands, and miners are of opinion that much of their gold goes into the tailings. This cannot be denied in view of the returns obtained from cyaniding during 1906 and 1907, more especially as the losses in the sands were still considerable.

In considering the value of the Munburra reefs this high loss is a matter of some importance, as it has been taken into account when deciding that certain stone could not be profitably treated. It is locally believed that there are large bodies of stone available, which would carry from ½ to 1 oz. gold per ton.

The price charged for crushing is 25s. per ton.

At the Cocoa Creek mines there is a 5-head iron-framed stamper battery with 16-h.p. engine and grinding pans—all in a ruined state. An old chlorination barrel shows that some experiments in treatment were carried out here.

OUTPUT OF THE FIELD.

The figures given below have been compiled from tables lent me by the Warden, Mr. Cherry, with additions made on the authority of Mr. Stuckey, the proprietor of the Starcke battery. They include the alluvial gold from the old diggings, the Munburra alluvial, the Munburra reef gold, and the alluvial and reef gold from Cocoa Creek. There is some doubt as to whether the whole of the 638½ oz. of gold placed as Munburra alluvial does not include gold dollied from the caps of reefs.

Old Starcke Alluvial.

	Tons cwt.	Oz. dwt. gr.	Yield per ton. oz. dwt.	Value per oz.(1) £ s. d.	Total Value. £
1890 ...	...	272 14 15	...	...	1,092
1891 ...	...	922 2 14	...	...	3,690
1892 ...	...	443 4 19	...	...	..
1893 ...	...	521 0 0	...	4 0 0	...
1894 ...	...	88 15 0	...	...	...
1895 ...	...	52 5 0	...	...	..
Total ...	...	2,300 4 0			

Munburra Alluvial.

1896 ...	...	364 9 12	...	...	...
1897 ...	...	274 0 0	...	4 0 0	...
Total ...	...	638 9 12			

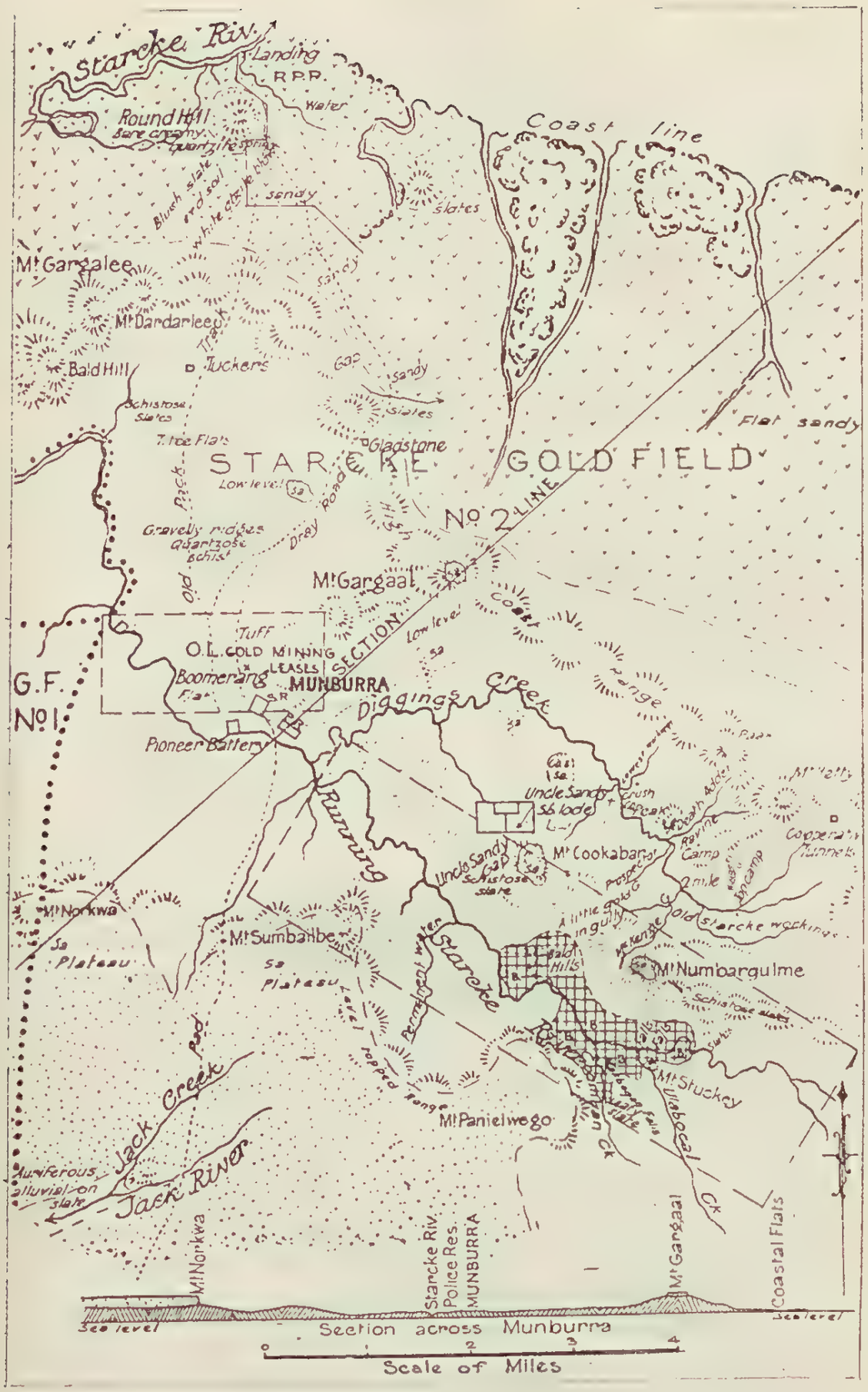
Munburra Reefs.

1898	...	189 15	1,246 15 11	6 11½	3 17 6	...
1899	...	1,130 17	2,655 11 11	2 7	...	...
1900	...	667 4	905 6 12	(2) 1 7	..	...
1901	...	279 5	(2) 1,054 9 0	3 16	...	...
1902	...	544 10	(2) 1,270 10 0	2 6½	..	..
1903	...	313 15	(2) 557 10 18	1 15½	3 15 10	...
1904	...	217 0	(2) 274 3 0	1 5	3 14 10	...
1905	...	58 0	74 0 12	1 5½	3 16 6	283
1906	{	46 0	41 19 0	0 18	4 4 0	...
	{	795 0	(3) 214 5 0	0 5½	3 3 8	...
1907	{	69 10	(2) 125 0 0	1 16	...	...
	{	(4) 224 10	(3) 45 19 0	0 4	..	...
1908	...	323 10	724 18 0	2 5	...	...
Total ...		4,858 16	9,190 7 16	1 18		

Cocoa Creek.

1892	...	16 0	41 0 0	2 11	..	...
1893	...	367 0	352 0 0	0 19	...	...
1894	...	561 0	539 0 0	0 19	...	...
1895	...	174 0	138 0 0	0 16	...	...
1896	...	21 0	38 0 0	1 16	...	...
Total ...		1,139 0	1,108 0 0	0 19½	3 18 0	

(1) The value of the Starcke has generally been placed at about £4 per oz., though in a great number of cases the miner actually received only £3 15s. to £3 17s. 6d. per oz. (2) Differs from Warden's report. (3) Cyanided. (4) *Queensland Government Mining Journal*, monthly reports.



MAP. 2.—GEOLOGICAL SKETCH PLAN OF PART OF THE STARCKE VALLEY.
Scale: 2 miles to an inch.

GEOLOGY.

The basal beds of the field are altered palæozoic sedimentaries which have been sharply folded, with the production of a certain amount of crushing. Interbedded with these are flows of leucophyre and beds of tuff, which appear to have some connection with the auriferous nature of the quartz deposited in fissures in the slates, subsequently to the folding.

Overlying the slates there is a moderate thickness of sandstone, conglomerate and shale, to which can with confidence be ascribed a Trias-Jura age.

The valley of the Starcke is similar to most of the other great depressions of erosion along the coastal escarpment, in having in its deepest part a small flow of basalt of quite recent age. Mention is made of other flows in my report on the Cooktown Coalfield (1), and it is there shown that they have probably a genetic relationship with the Cook uplift, during which the Trias-Jura beds along the coast were elevated more than 1,000 ft.

Palaeozoic.

Sedimentaries of undetermined age, but probably belonging to the palæozoic system and comprising shales, slates, sandstones, greywackes, tuffs, and leucophyres form the basement of the Starcke. The slates in places near reefs have been greatly silicified, presumably by the spreading out of the solutions that brought in the auriferous quartz. In other parts they exhibit an "augen structure" due to crushing, a continuance of which has sometimes produced a well-marked schistosity.

The tuff rock at the surface has the appearance of a very fine-grained micaceous grit, but at a moderate depth this changes to a dark blue siliceous and micaceous greywacke. Such a rock forms the country at the Last Hit and Queen Alexandra. That at the Last Hit is composed chiefly of angular fragments of quartz and plagioclase in a siliceous and chloritic base. The rock at the Queen Alexandra is neutral tinted, and rather more siliceous than the above, the felspars are slightly kaolinised, and a little pyrite is present. Here also occurs a rock provisionally regarded as tuff, its components being quartz, orthoclase and plagioclase set in secondary silica and calcite. The rock from Mount Hetty, on the old diggings, differs somewhat in that the base is more distinctly felspathic, the bluish colour of the rock being derived from finely divided chloritoid.

The working out in detail of the geology of the area will be greatly complicated by the occurrence of very fine-grained sandstones, which it is scacely possible to distinguish without microscopic examination from the micaceous tuffs.

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(1) *See* Q.G.M. Journal for April, 1909.

"Dykes."

Undoubted igneous rock was collected at the Rapport shaft, on the Boomerang P.C., the Queen Alexandra, the Rio Tinto, the Lily of the Valley, the Gold Mount, and Butcher's. It varies only from a felsite to a quartz porphyry, and may therefore be considered as derived from one magma, and on account of its light colour may generally be referred to as leucophyre. In some places, as at Rapport's shaft, it is a devitrified felstone; at the Queen Alexandra the felspar and quartz occur as phenocrysts, and the base is sometimes spherulitic. Specimens obtained in the vicinity of the Mountain Maid and Gold Mount have suffered much replacement by secondary silica. On the whole the evidence afforded by a microscopic examination is in favour of a volcanic origin as against hyperbyssal, and the association of acidic tuffs points in the same direction. Nevertheless, the data obtained in the field, it must be admitted, are inconclusive, most of the specimens of undoubted igneous rock obtained having come from inaccessible shafts. On the accompanying map the leucophyre is shown in belts, but it cannot be asserted that the rock will be found continuously along these lines. In all probability the outcrops found are quite disconnected along the surface, though generally alligned as shown. Then again the rock has suffered such extensive weathering that it is often difficult to distinguish it in the field from accompanying micaceous tuffs and sandstone, which are generally classed as "porphyry" by the local miners.

Felsitic rock was also noticed at the western end of the First Call lode at Cocoa Creek, thus bringing the conditions on the two fields into agreement.

REEFS.

The Munburra reefs are located in the stumps of an ancient and now worn down mountain chain, and it might therefore be argued that they are also of great age, but that does not necessarily follow. It is nevertheless more than probable that the metalliferous solutions became active prior to the Cook uplift, elsewhere referred to. Such being the case, one would not expect to find quartz veins in the overlying Trias-Jura sandstones.

In all, some 26 reefs have yielded crushing stone. It has been stated that the reefs have a general east-west trend, and are connected with north-south dykes of porphyry, but this is to be taken in a very general sense, for though the mean trend may be east-west, the strikes vary from south-west to north-north-west. That the gold-bearing reefs have some connection with porphyry dykes is also undeniable, but the relationship of these dykes to the country is not at all plain. While most of the reefs have a strike diagonal to that of the dykes, there are exceptions, of which the best examples can be seen on the Starcke Consols lease, where quartz leaders run along either or both sides of the dyke.

The occurrence of gold is very patchy, and the shoots generally have the form of pipes pitching westwards. At the Last Hit (and possibly at the Boomerang and Queen Alexandra) the auriferous shoot is widening as depth is attained.

The reefs branch frequently or fray out; they are distinguished by much slickensiding; and they are of the class known as metasomatic or replacement fissure veins. Some of the fissures may, and probably do, have great length, though quartz has been deposited along them in comparatively short bunches. The fissuring has been followed in most cases by some movement, causing crushing of the wall rocks. Siliceous solutions have percolated along the resulting planes of weakness, from which they have sometimes spread out metasomatically replacing practically the whole of the intervening country rock.

A banded structure, brought about by parallel lines of dark-coloured chloritic mineral, is typical of the quartz on both the No. 1 and the No. 2 fields. Calcite occurs sometimes in thin sheets, and mispickel crystals are often plentiful in the crushed rock, but pyrite was observed less frequently.

All stages in the process of replacement can be observed, sometimes in a single hand specimen, and the vein thus sometimes has a pseudo-brecciated appearance, owing to included unreplaced fragments of country rock. This structure is shown in Fig. 2. Microscopic examination of a thin slice taken from this specimen, which is from the Hit or Miss reef, has resulted in the discovery that the quartz is accompanied by much plagioclase, as depicted in Fig. 3. This section

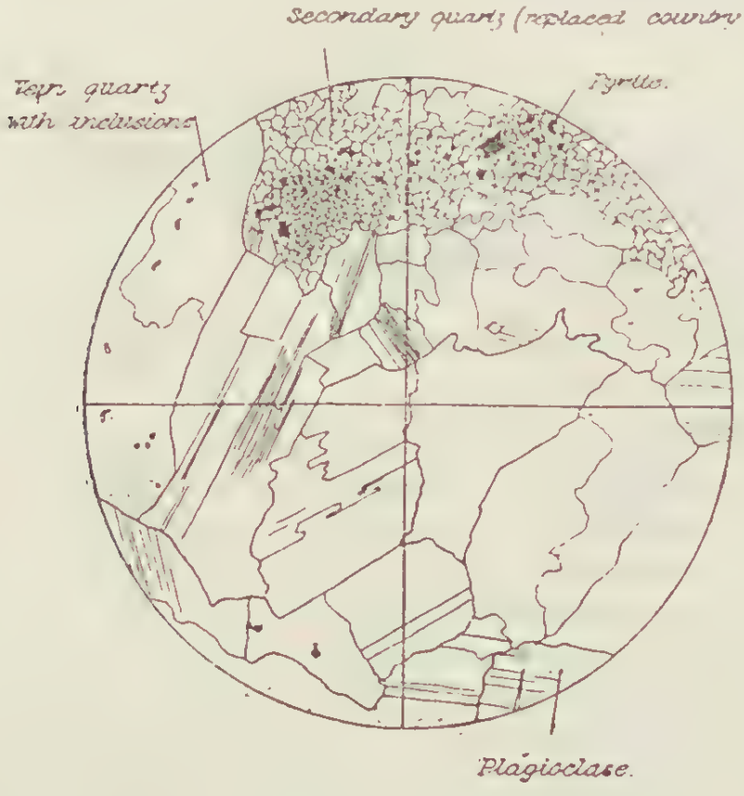

Fig. 3.—Vein Felspar and Quartz, with Slate Inclusions. (portion of specimen shown in Fig. 2.) Hit or Miss. X 20.

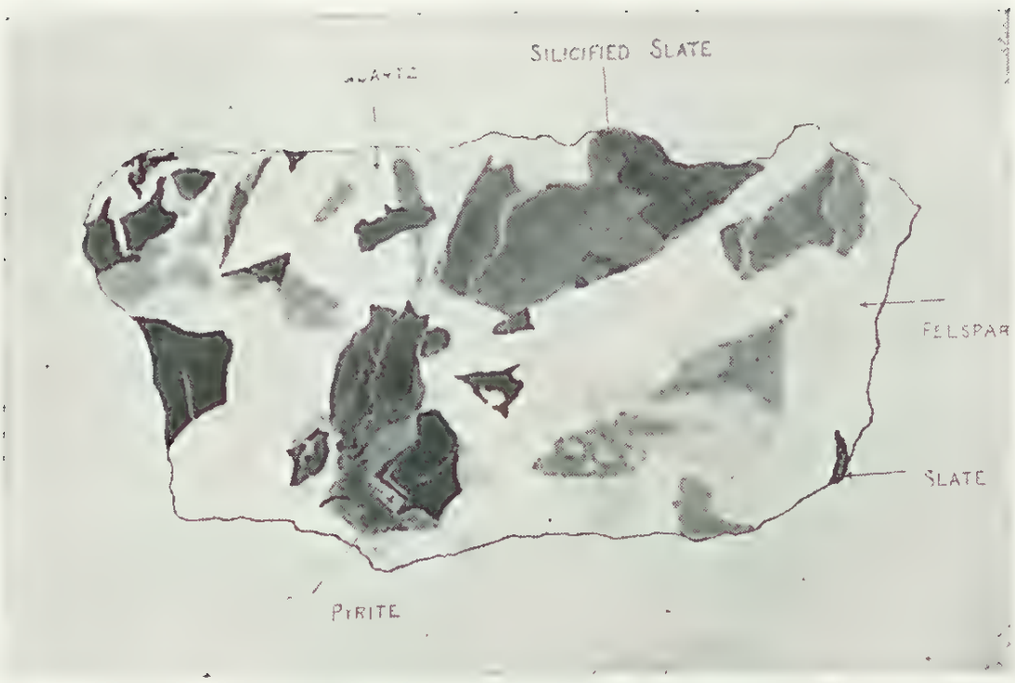

FIG. 2.—GOLD-BEARING ORE (SLATE IN PROCESS OF REPLACEMENT BY QUARTZ AND FELSPAR). HIT OR MISS. X 2.

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shows that the included fragments of country have been replaced by a fine mosaic of secondary silica, while the coarser quartz and the felspar occupy the open spaces between those fragments. The discovery is of much interest, as having a distinct bearing on the origin of the vein quartz and gold of the whole field, for plagioclase was also detected in small quantities in rich ore from the 125-ft. level of the Last Hit. The only previous description known to me of felspar occurring in an Australian gold-bearing reef is that of Lindgren, (1) who found crystals of albite intergrown with quartz in small drusy cavities at the South New Moon Mine, Bendigo, Victoria. Albite had previously been discovered in the gold-quartz veins of California and Alaska, while orthoclase is abundantly developed in certain veins occurring in tertiary lavas—*e.g.*, in Idaho, Colorado (Cripple Creek), Nevada (Tonopah), and New Zealand (Waihi). From this Mr. Lindgren tentatively concludes that the kind of felspar is in some way dependent on the depth at which it was deposited, the orthoclase-bearing reefs having been formed much nearer the surface than the gold quartz veins of California, Alaska, Victoria, and, we may add, Queensland.

Trias-Jura.

The escarpments and table-tops of the Trias-Jura beds are the most prominent feature of the topography of the Starcke field. No fossil evidence as to their age was secured locally, but they can be traced without a break southwards to the railway line, where Trias-Jura fossils have been obtained. (2) Mr. Webb informed me that fragments of coal were obtained by him on the north branch of the Jack River, the first stream of importance south of the Starcke. On Mount Cookabar (the nearest mesa to the mines) the basal beds are conglomerate, above which there is ferruginous shale overlaid by sandstone.

Occasional small areas of sandstone were noticed in the Starcke Valley quite 1,000 ft. below the base of the plateau beds, and an attempt was made to account for them by trough faulting, but it seems much more likely that they are simply residual masses of the beds which formerly extended over the valley. One stretch, ½ mile long and 1 ch. wide, is crossed on the track 1½ miles east of Munburra. Some of the boulders have been hollowed out presumably by wind action following on crustal induration by atmospheric agencies.

Basalt.

A narrow flow of basalt occupies the bed of the Running Starcke River for about 3 miles above the Bald Hills, which are probably on the site of the orifice from which the lava flowed. The upper part of

(1) Economic Geology, Vol. I., p. 162.

(2) See Geological Reconnaissance of the Cooktown Goldfield. Q.G.M. Journal for April, 1909.

the flow is coarsely vesicular, while the central portions are incipiently columnar. This structure has resulted in the production of several falls in the river, the Ulabocal Falls being 25 ft. deep, and the Marbogan Falls 60 ft. This may be taken as the thickness of the flow at the latter place. The width of the flow would seem to have been never more than ½ mile. Microscope sections reveal the presence of much fayalite, with felspar laths and magnetite grains in a glassy base.

AURIFEROUS ALLUVIAL DEPOSITS.

The auriferous alluvial deposits of the Starcke fields are unfortunately of exceedingly limited extent, comprising as they do only the modern wash in the beds of creeks, gullies, and ravines. In all cases, except the Jack, the gold is connected with the occurrence of felsite or leucophyre.

Old Starcke.

The Old Starcke alluvial workings are at the head of Diggings Creek in about the centre of the No. 2 goldfield, and 4 miles east of Munburra. Gold was discovered here in 1890, and some 200 men were employed gully-raking for a period of six months. Nuggety, McKenzie's and Prospectors' Gullies were the most productive. Several other ravines, including Bearaway and Fearaway, yielded coarse gold, nuggets of 37, 32, 27, 25, 15, and 10 oz. having been reported from the latter, and one nugget of 14 oz. was found in the first-mentioned.

Death-adder Gully was noted for the coarseness of its gold, but the patches were too far apart for profitable work. A little gold was also got all along the main creek bed, the best return being from just below the Top Camp.

Output (*See* Output of the Field):

1890 to 1895—2,300 oz. 4 dwt. gold, worth £4 per oz.

Munburra.

Gold was discovered in Kitty Gully by Webb and party when on a prospecting expedition subsidised by the Government. The gully proved auriferous for a distance of only 3 or 4 ch., and it is said that not more than 50 oz. of gold could have been taken from the bed, the section of the ravine being V-shaped, as flats had not yet been formed.

Several other adjacent gullies were afterwards raked for small returns, the gold in all cases being found below crops of tuff or leucophyre; and that from Starlight Gully was the coarsest recorded. The flats below the Boomerang reefs are promising, but are stated to have been tested for very poor returns. Antimony Creek, which comes down from the Uncle Sandy Mine, was also payably auriferous for a short distance on the flats.

Output (*See* under Output of the Field):

1896 and 1897—638 oz. 9½ dwt. gold, worth £4 per oz.

Jack River.

A little coarse gold has been found in alluvium on the Jack River in the south-western corner of the No. 2 field, about 8 miles south of Munburra. The country is stated to be slate capped on the ridges by sandstone and conglomerate. The find was of little importance, not more than 20 oz. being secured. An interesting discovery, that of a 4-gr. speck of gold in the conglomerate, was reported by Mr. J. W. Webb; but all further testing of the same rock by dollying failed to locate another "colour." Mr. Webb states that the gold was enclosed in a quartz pebble, indicating that the reefs are older than Trias-Jura.

This small patch is of much interest, as it indicates the general auriferous nature of the whole area between the Cocoa Creek and Munburra workings, unfortunately now covered in great part by thick beds of barren arenaceous sedimentaries.

Cocoa Creek.

Most of the alluvial workings, the deepest of which was 11 ft., are on the northern slope of the low ridge between Cocoa and Yamba Creeks, heads of the McIvor River, and in the south-eastern corner of the Starcke No. 1 Goldfield.

The old surface workings extend over a width of ½ ch., for 5 ch., beginning 5 ch. north of the gold-antimony lode, elsewhere referred to, with which they have no apparent connection.

The country rock is indurated quartz-veined slate, from leaders in which the gold would seem to have been shed. Much "specimen gold," *i.e.*, gold attached to quartz, was found in the soil here, and from one claim was collected 12 tons of rubble, which yielded 4 oz. gold per ton. The gold here, as on the No. 2 field, was worth £4 per oz.

The short gullies running southwards into Cocoa Creek from the antimony lode have also been raked for gold.

There seems to have been no record kept of the amount of gold obtained in these old workings.

HOLDINGS.

At the end of 1908, there were in force only four leases: G.M.Ls. 17, 21, 24, and 25, and two claims: M.Cs. 117 and 118. The most unfavourable sign was the absence of any registered prospecting areas. The only mining going on at the time of my visit was on the Last Hit and the Rio Tinto.

The Starcke United G.M. Co., Ltd., is the registered holder of Gold Mining Leases 17 (the Last Hit, 5 ac. in area), 21 (the Starcke King, 22 ac. in area), and 24 (the Starcke Boomerang, 3½ ac. in area).

For purposes of description the reefs will be taken in alphabetical order, and where possible under the name of the original proprietor. This will cause no trouble, as the reefs seldom crop beyond the one claim or lease.

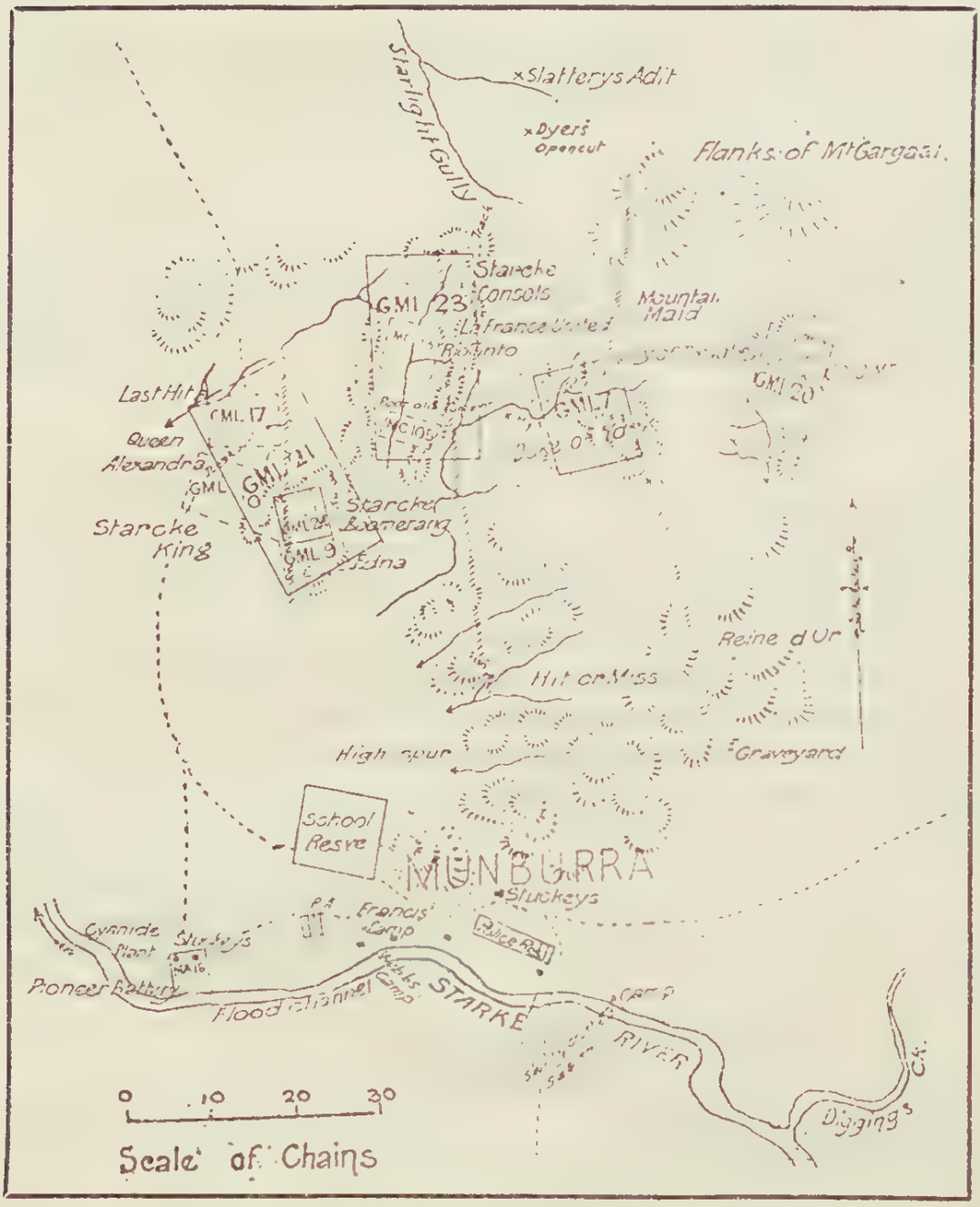

FIG. 4.—PLAN OF STARCKE LEASES, SHOWING LEUCOPHYRE AND TUFF BELTS.

Boomerang P.C.

This claim is now included within M.L. 24, which lies a little over ½ mile north-north-west of the Munburra police reserve, and is held by the Starcke United Company. Three distinct lines of reef were worked on it, the quartz being most highly auriferous where milky, and especially where black laminæ are numerous.

The main line, dipping about 80° northwards, runs east-south-east from the western side of the lease for 1 ch., and then suddenly

bends to the east-north-east, and frays out within a chain. The vertical whip and underlie pump shaft on this are said to be 90 ft. in depth, but no means had been provided by the manager for making a descent. The underlie shaft is said to have struck the reef at 72 ft. below the surface, and to have been continued on the underlie, with considerable difficulty owing to the heavy water met, necessitating first the erection of a horse-whim and later the installation of a steam pump.

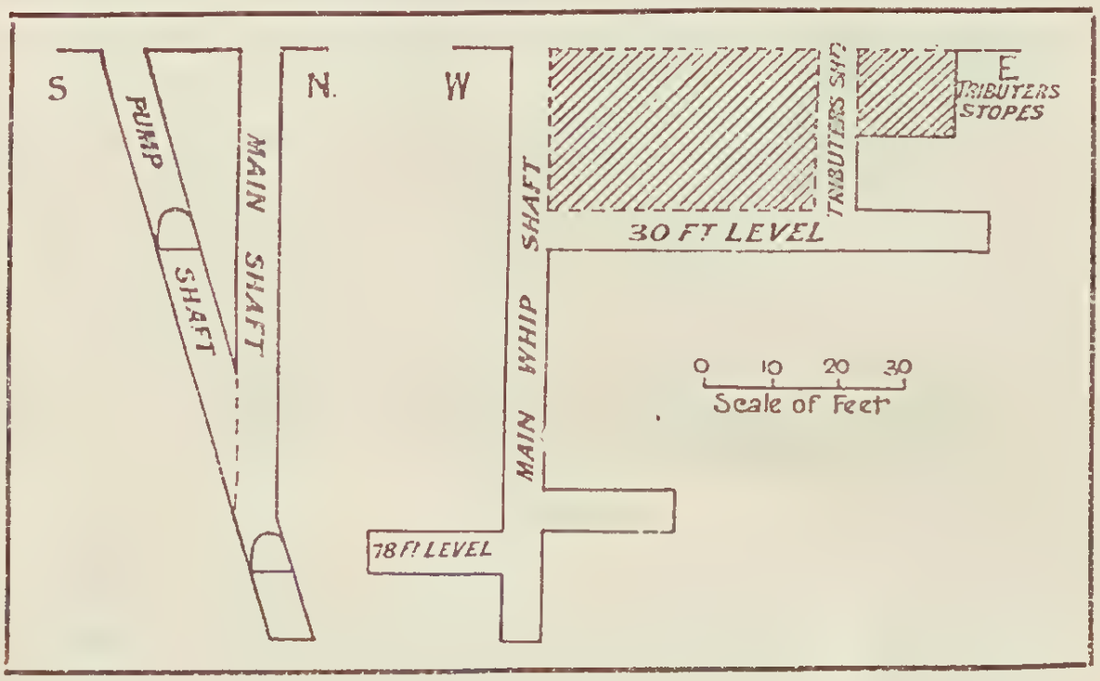

Fig. 5.—The Main Boomerang Workings.
By Lionel C. Ball, B.E.

It is understood that drives were carried 20 ft. both east and west at the 78-ft. level, and for 65 ft. east at the 30-ft. level; and that the reef has been stoped out above the latter level for 30 ft. from the shaft. Rich stone is said to have been taken out at the 55-ft. level.

The tributers' shaft, at the eastern end of the stope above the 30-ft. level, was sunk by a party of men, while waiting to begin work on the Last Hit. A small block of the reef about 15 ft. square was broken down by them and 5 tons of the ore (bluish glassy quartz, with laminations and inclusions of country rock) is still stacked at the surface. A surface sample of this has been assayed as below (Government Analyst):

Gold	12 dwt. 19 gr. per ton.
Silver	2 dwt. ,,

A parallel leader to that worked by the tributers, about 20 ft. to the south-south-east, has been sunk on, but the shaft is too old to allow of an examination.

A second line of reef, striking east 10° south and dipping 80° northwards, lies 40 ft. north of the main line at the vertical shaft, and

seems to run from the No. 1 W. shaft. A shaft sunk to 50 ft. below the surface is now half full of water, but the reef can be seen in the upper part to be about 6 in. wide and fairly uniform in width, though there is a slight pinch at 20 ft. depth, and blocks up to 12 in. across have been raised. The quartz is crystalline, and contains inclusions of country but, though there were good prospects on the surface, little gold was got below. The foot-wall country is a dark micaceous sandstone, striking north-north-west, but the hanging-wall is porphyry, and in this are the inclusions.

At 40 ft. west of this shaft there is another, 30 ft. deep, but fallen in, and here also quartz-felspar-porphyry is showing. The belt of porphyry would, in fact, seem to run westwards here to the boundary of the P.C. when it bends to the south again.

A little gold-bearing stone was taken from a trench within the P.C., on the line of the No. 1 E. workings, but quite 1½ ch. from them.

In the northern part of the claim there is an old shaft on an east-west leader, from which a bunch of pay quartz was taken. The shaft is in porphyry.

Output:

	Tons cwt.		Oz. dwt. gr.
July, 1898	...	crushed for	250 0 0 (1)
August, 1898	6 10 (2) (3)	,,	38 0 0
April, 1899...	15 10 (3)	,,	47 10 0
July, 1899	3 0 (3)	,,	26 3 0
September, 1899	1 10	,,	1 2 12
,, ...	4 0 (4)	,,	1 10 0
October, 1899	7 0 (5)	,,	2 2 12
,, ...	3 0 (6)	,,	121 12 0
,, ...	40 0 (5)	,,	5 0 0
December, 1899	29 0	,,	52 6 0
,, ...	1 10 (6)	,,	54 0 0
May, 1900	11 0 (7)	,,	24 0 0
May, 1901	5 0 (8)	,,	101 0 0
September, 1901	10 0 (8)	,,	95 0 0
February, 1902	8 0 (9)	,,	90 0 0
April, 1902...	13 0 (10)	,,	89 0 0
November, 1902	23 0 (10)	,,	87 0 0
February, 1903	9 5 (10) (11)	,,	14 10 0
Total	190 5	,,	1,099 16 0

(1) Estimate of dollyings by Mr. Webb. (2) Seconds from dollyings (4 or 5 cwt. yielding 1 to 3 oz. to dish). (3) Pump shaft. (4) Seconds. (5) Surface floaters on flat below main shaft. (6) 55 feet depth in pump shaft. (7) Surface holes, mixed country. (8) Cooktown Boomerang Gold Mining Company, from main shaft. (9) Raised by prospectors. (10) Queen Alexandra Company. (11) Bottom of main whip shaft.

Boomerang No. 1 W.

A little work was done on the western part of the main P.C. reef, but the chief operations were carried out on the southern end of the Ruby United line. The reef underlies 45° to the south-west

One shaft to the west of the Boomerang workings is 60 ft. deep, and from it stopes, now fallen in, extend for 50 ft. to the south-east. These reach from the surface to the 30-ft. level. At the 60-ft. level there is a drive for 40 ft. to the south-east, and from it a winze has been sunk a few feet.

The reef has been followed and trenched or sunk on to shallow depth for 2 ch. to the south-east of the shaft and for 5 ch. to the north-west-by-north over a steep ridge, where are the Ruby United workings.

Output (1):

	Tons	cwt.		Oz.	dwt.	gr.
November, 1898	17	0	crushed for	59	2	6
September, 1899	22	0	,,	87	14	0
January, 1900	9	12	,,	15	10	0
May, 1900	11	0 (2)	,,	19	0	0
Total	59	12	,,	181	6	6

(1) Gorton and Fitzgerald. (2) Porphyry shaft on main Boomerang line.

Boomerang No. 2 W.

A shaft has been sunk 15 ft. on a north-west striking leader on the claim, which is on the western side of the Starcke King. A number of trenches have been opened, but proved that there was only one small bunch of payable ore here.

Output:

June, 1899—4 tons crushed for 7 oz. 13 dwt.

Boomerang No. 1 E.

It was formerly considered that the eastern numbers of the Boomerang were on the same line as the P.C., but my map shows that they are on a parallel line, lying quite 2 ch. north of the line of strike of the reef worked by the P.C. tributers. The fact that the pump on the P.C. line had no effect on the level of the water in the eastern workings conclusively proved the absence of any connection.

The reef strikes north-east-by-east and underlies 45° to the north-westwards. It was probably small but very rich.

The old workings, which comprise two vertical and two underlie shafts, are now quite inaccessible, and very little can be learnt as to the nature of the reef or the extent of the workings. The easternmost underlie is known as Dyer's whip shaft, and, to judge from the size of the tip, much driving must have been done here, in sandy shale and slate country and pyritous formation. A 5-oz. leader was stoped in

the second underlie shaft, and a vertical shaft was begun a few feet to the north-west of this, but was not sunk far enough to reach the reef. The westernmost shaft was sunk 30 ft. vertically, and then on the underlie. The vertical sinking was in micaceous and felspathic sandstone, the underlie being on a slightly quartz-bearing formation of the same rock. The reef does not seem to have extended beyond this shaft to the westwards, a deep costean in the P.C. having failed to locate any sign of it.

Output:

	Tons	cwt.		Oz.	dwt.	gr.
November, 1898	13	19	crushed for	18	7	8
September, 1899	7	10	,,	15	4	0
January, 1900	3	7	,,	16	15	0
October, 1900	5	5 (1)	,,	53	15	0
February, 1901	4	0 (1)	,,	10	3	0
,, ...	26	10 (2)	,,	241	8	0
,, ...	10	0 (3)	,,	3	7	0
September, 1901	16	0	,,	45	0	0
June, 1902	7	15	,,	19	0	0
December, 1902	20	0	,,	40	0	0
April, 1903	9	10	,,	22	10	0
September, 1903	13	10	,,	71	10	0
October, 1903	14	0 (3)	,,	14	0	0
,, ...	12	15	,,	83	16	0
August, 1904	12	0	,,	28	10	0
Total	176	1	,,	683	5	8

(1) Dyer. (2) Chapman. (3) Headings.

Boomerang No. 2 E.

The Boomerang No. 2 E. workings are on the continuation of the No. 1 E. reef, which here strikes more nearly to the north-east. In the early days some open cutting was done on the reef just outside of M.L. 24. No. 1 shaft, now known as Stuckey's, was sunk 1 ch. north of the north-eastern corner of M.L. 24 and adjacent to this open-cut, being 40 ft. vertical and 30 ft. on the underlie. The country rock at the surface is thin bedded sandy slate striking north 30° east and vertical, but that raised from a depth is a bluish crush rock.

No. 2, or Owen's shaft, is adjacent to the north-eastern corner peg of M.L. 24. This is said to have been sunk following "colours" to a depth of 40 ft., where 12-oz. stone was struck. At the 70-ft. level there is said to be a drive south-westwards to the boundary of the No. 1 E. and north-eastwards for 1 ch.—the whole of the drive being on gold-bearing stone. It is locally believed that the tip at this shaft contains payable stone, but my surface sample, from 10 tons of pyritous formation stacked at the shaft, contains only traces of gold and silver (Government Analyst).

Output:

	Tons	cwt.		Oz.	dwt.	gr.	
November, 1899	2	10	crushed for	1	14	0	
March, 1901	2	15	,,	22	5	0	
November, 1901	14	0	,,	173	12	0	
January, 1902	20	0	,,	174	10	0	
February, 1902	3	10	(1) ,,	9	13	0	
June, 1902	26	15	,,	170	0	0	
March, 1903	20	0	,,	34	10	0	
December, 1903	8	0	(2) ,,	14	2	0	
April, 1904	12	0	(3) ,,	1	4	0	
December, 1905	5	0	(4) ,,	12	2	0	
December, 1906	8	0	(4) ,,	13	3	0	(5)
Total	122	10	,,	626	15	0	

(1) Warden—"Various lots." (2) Not given by Warden, *fide* Mr. Stuckey. (3) Headings. (4) Held with other claims as Boomerang Extended. (5) *Fide* Mr. Stuckey. Not given by Warden.

Boomerang Extended.

The Boomerang Extended (M.L. No. 10) included the eastern part of the reef worked on the Boomerang Nos. 1 and 2 E.

Stuckey's shaft is on the ridge top, outside of the Starcke United Company's lease. It is 35 ft. deep, and has a drive west at the bottom.

A little laminated quartz, carrying 1 to 1½ oz. per ton, was found while sinking in a loose formation, but it cut out above the bottom of the shaft.

Output: *See* Boomerang No. 2 E.

Butcher's.

Butcher's workings are on the crest of a high ridge, ¾ mile north-north-east of the Munburra police reserve. They comprise six old shafts and various trenches. The ground was being tested by Fahey at the end of the year, and his shaft was then 15 ft. deep. All that could be seen was a leader running east and west across a belt of felsite. This is said to have been the first reef located at Munburra, and one dishful of dirt at the surface yielded 7 oz. of gold.

Fahey had 8½ tons of stone lying at the battery waiting to be crushed, and 3 tons of seconds at grass.

Cocoa Creek.

The Cocoa Creek gold-antimony lode was discovered in 1890, and the Warden reported in 1891 that six claims were at work, but by 1893 all had been abandoned except the P.C., on which work continued till the beginning of 1896.

Mr. Rands reported (1) in some detail on the claims in force at Cocoa Creek in 1893.

In 1900 a lease of 5 ac., known as the First Call, was secured, but no work appears to have been carried out until 1906, when an English firm was induced to take an option over the property with a view to proving the reported existence of large deposits of antimony ore. The disappointing results obtained led to the speedy closing down of the mine, and towards the end of 1908 the winding gear was removed to the Starcke Consols.

Six shafts have been sunk to various depths over a distance of 10 ch. The main or No. 2, and the No. 1 shafts, which are both 150 ft. in depth, are connected by a drive at the bottom, above which the ore has been stoped out. After having been unused for several years the English firm cleaned out the No. 2 and reopened the bottom drive. About 5 ch. to the east-south-east there are two old shafts 70 and 30 ft. in depth, only 1 ch. apart but not connected. Going westwards there is an old shaft 2 ch. from No. 1 and 20 ft. above it; and 1 ch. beyond it is an open-cut on the ridge top. Another 70 ft. shaft lies 3 ch. south of the main shaft.

The chief lode strikes about east 30° south, underlying southwards at an angle of 85°. A second lode, said to run due west from the eastern shaft, has been sunk on to a depth of 70 ft. in one place.

Nothing can now be seen of the crops, but it is understood that the main reef averaged about a foot in thickness, with bunches quite 4 ft. across. Residual lumps of oxidised antimony ore were found in the surface workings, and these carried from 3 to 5 oz. of gold per ton. At a shallow depth stibnite was met, chiefly in the central portion of the quartz reef, but from the sulphide ore not more than 1 to 2 oz. per ton could be extracted. As sinking continued the percentage of antimony perceptibly decreased, and with it the gold, and it is said that the optionists were able to secure only 2 tons of 50 % ore at the 150-ft. level—such a disappointing quantity that work at once ceased.

The quartz on the tip at the No. 2 shaft is laminated, and contains inclusions of bluish crushed country rock, and generally resembles that of the Munburra reefs. The associated stibnite makes the resemblance to the Uncle Sandy ore complete—though the mines are 17 miles apart.

The surface rocks at the main workings are a light-coloured gravel-forming schist and slate, striking north and south, but from the lower workings much bluish, partly crushed, speckled tuff has been raised. The crushed rock contains sporadic crysfals of pyrite, and most likely comes from a formation adjacent to the reef.

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(1) Geological Observations in the Cooktown District, by William H. Rands, Assistant Government Geologist. Bris.: By Auth., 1893.

The eastern workings yielded some 2-oz. stone, but this portion of the reef was very poor in antimony.

The western open-cut is on the western side of a north-south crop of quartz-veined felsite, and the occurrence is very similar to that at the Gold Mount, 18 miles to the north. A local tradition has it that a trial crushing from here yielded 5 dwt. per ton.

Output ([2]):

	Tons.		Oz.
1892	16	crushed for	41
1893	367	,,	352
1894	561	,,	539
1895	174	,,	138
1896	21	,,	38
Total	1,139	,,	1,108 ([3])

([2]) Annual Reports of Department of Mines.
([3]) Average value, £3 18s. per oz.

Duff's.

Duff's shaft is at the head of the Boomerang ravine, between the Starcke King and Starcke Consols leases. It was 30 ft. deep, but has caved-in, and the leader cannot be seen.

Output:

August, 1901—2 tons crushed for 1 oz. 11 dwt.

Duke of York.

The Duke of York (G.M.L. No. 7), now forfeited, lies ¾ mile north-by-east from the police reserve. A Maryborough-Gympie Syndicate had two men working here for a time, and towards the end of the year a claim (M.C. No. 118) was applied for, but, there being no one on the ground, it was not located by me.

The Duke of York workings are in proximity to a dyke of porphyry that can be traced from beyond the Mountain Maid on the north to Butcher's on the south. The northernmost comprise potholes on a shoot that has given good returns outside the lease. Half way down the lease there are a shaft, 25 ft. deep, and an adit, 30 ft. long, above which a stope extends for 10 ft. Then in the south-eastern corner there are several old shafts on a reef less than 10 in. thick.

Surface stone from several shoots along the line is said to have been dollied with good results. The reef in the shaft is believed to be about 8 in. wide, but there is on the tip much dark blue, quartz-veined, pyritous formation (crushed rock) as well.

Output ([1]):

	Oz.	dwt.
1898—Dollied by Mr. Webb	20	0
October, 1901—3 tons crushed for	8	2
Total	28	2

([1]) It is understood that a quantity of stone from this mine was crushed with some from the Hit or Miss.

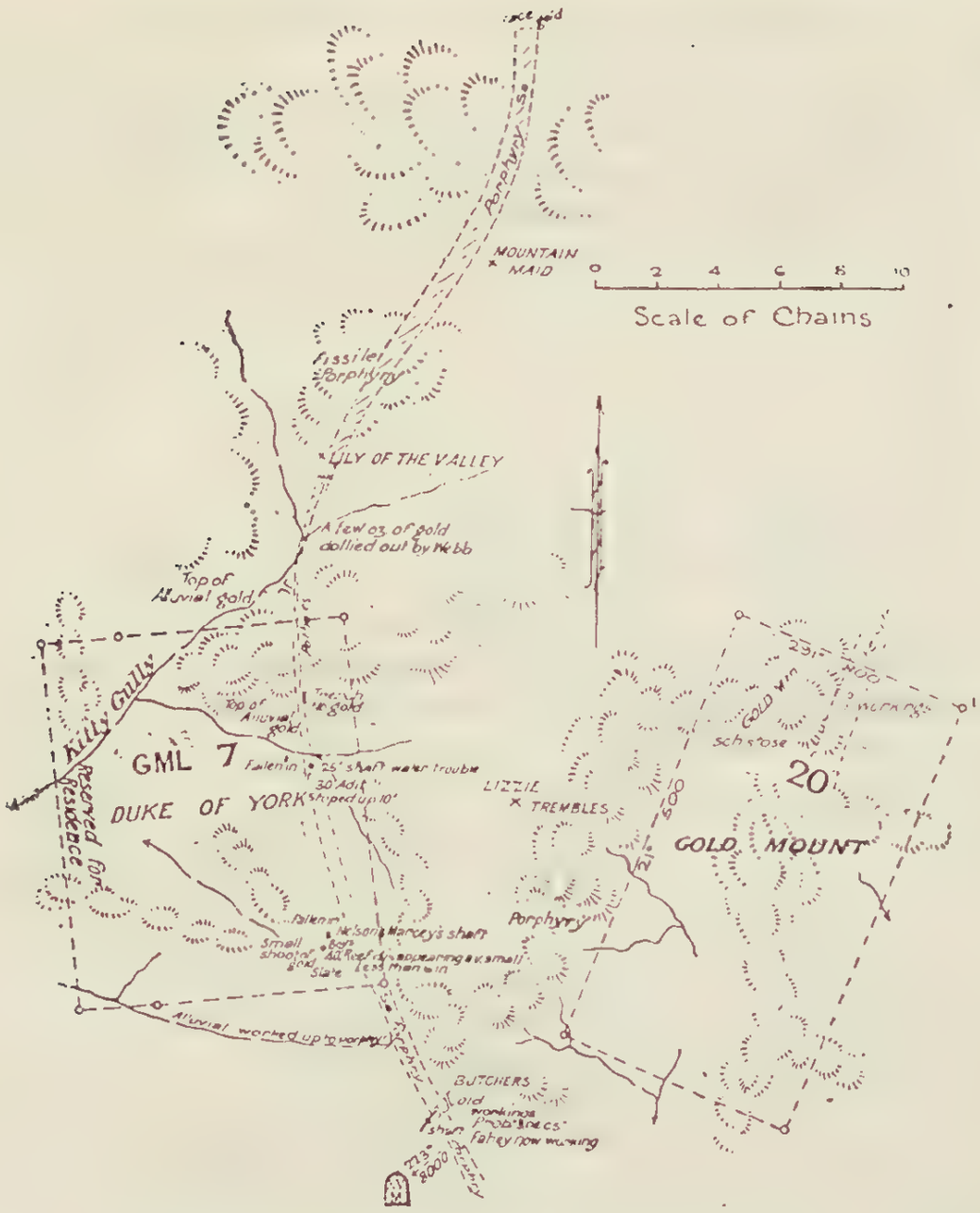

FIG. 6.—DUKE OF YORK AND GOLD MOUNT LEASES.

Dyer's.

Dyer's shaft, 20 ft. deep, is in the north-eastern corner of the Starcke Consols lease. It is now caved-in, and nothing can be seen of the reef, but some stone from here was mixed with the Starlight crushing.

A tribute party is said to have got a return of 3 oz. per ton from some stone from here.

Edna.

The Edna workings are now included in the southern part of the Boomerang United lease (G.M.L. No. 24), which is held by the Starcke United Company.

Two shafts were sunk on the underlie by the original holders to the boundary of the Queen Alexandra lease, at 30 ft. below the

surface. These are about a chain apart, and between them a number of cuts and potholes expose a 6-in. reef of laminated quartz, left because comparatively poor. Very rich dollying stone was reported from the upper part of the eastern shaft. The reef worked (the Queen Alexandra) makes a sudden bend just beyond the western shaft and enters the adjoining ground, wherefore no further work was to be done on it in this lease.

A shallow hole about 2 ch. to the north of the above workings exposes a reef, 6 to 12 in. thick, which is said to carry 5 dwt. per ton. The reef is accompanied by a formation 2 ft. wide.

Output:

	Tons	cwt.		Oz.	dwt.
February, 1902	8	0 (1)	crushed for	120	0
May, 1902	6	0 (2)	,,	30	0
August, 1903	2	10 (2)	,,	9	12
April, 1904	10	0 (3)	,,	1	14
Total	26	10	,,	161	6

(1) Gorton and Treveny from outcrop. (2) Boomerang No. 1 S. (3) Edna.

First Call.

See Cocoa Creek.

Francis.

The Francis shaft is near the centre of the Starcke King (G.M.L. No. 21). It is probably 30 or 40 ft. deep, but water is standing at 10 ft. below the surface. The leader strikes north 55° east, in crushed blue shale, and it consists of laminated quartz, having a strong odour of sulphuretted hydrogen and including fragments of country rock.

Output:

October, 1900—3 tons crushed for 2 oz. 13 dwt.

Gladstone.

The Gladstone lies on the seaward slope of the coast range, 3 miles north-north-east of Munburra, and the workings are 5 ch. east-south-east of the road to the Starcke landing.

The country strikes north 35° east, but the reef runs almost due west.

The upper adit is within 50 ft. of the ridge top, and 70 ft. below it a second adit was commenced, but has fallen in. The adits are 2 ch. apart. A vertical shaft has been sunk from the surface to the upper adit, 30 ft. back from the mouth, and continued as an underlie to the 85-ft. level, where there is a drive for 30 ft. to the west, below which a now inaccessible winze has been sunk 40 ft. There are drives at the 40-ft. level for 25 ft. west and 30 ft. east, and at the 75-ft. level for 10 ft. west and 20 ft. east. The blocks of ground above the

40-ft. level east and below the 75-ft. level west have been stoped out, besides which a little stoping has been done between the top adit and the 40-ft. level west, and between the 40-ft. and 75-ft. levels east.

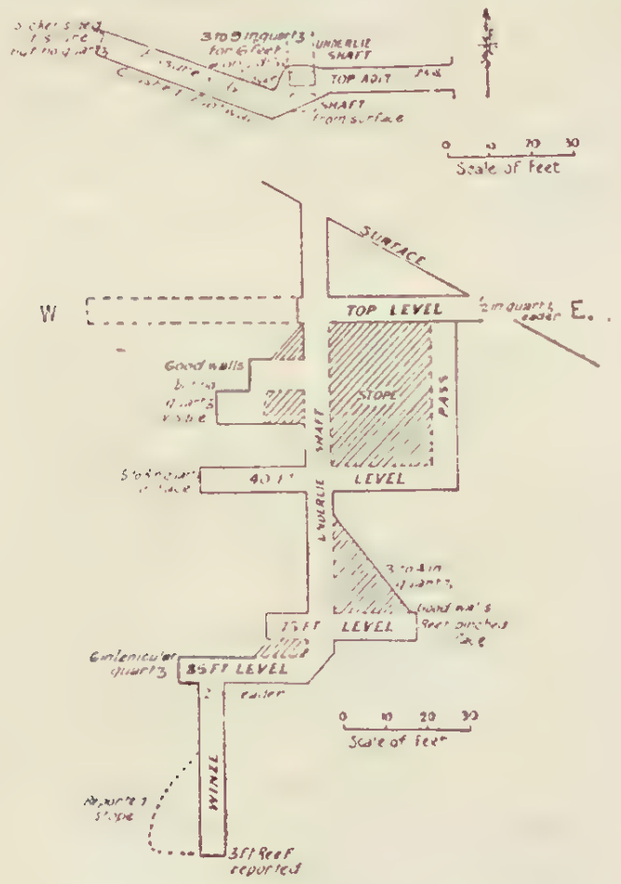

Fig. 7.—The Gladstone Workings.

In spite of the comparatively large output very little can be seen of the reef in these workings. At the mouth of the top adit there is a ½-in. quartz leader, and the adjacent tuffaceous country is strongly iron-stained over a width of 8 or 10 ft.; and just beyond the underlie shaft a reef, 3 to 9 in. thick, extends for 6 ft., but beyond that there is only a strongly slickensided fissure. In the face of the 40-ft. level west there is 5 to 8 in. iron-stained crystalline quartz. Above the 75-ft. level 3 to 4 in. of quartz has been left in the stope, but the reef pinches out completely in the face of the eastern drive. On the 85-ft. level there is 6 in. of quartz in the western end, but only 2 in. above the winze, in which it is said 3 ft. of quartz was worked. (This, unfortunately, could not be examined, owing to the state of the ladder below the 85-ft. level.)

There would appear to have been a shoot of payable stone, 50 ft. in greatest length, between the top adit and the 40-ft. level. This pitches steeply to the westward and contracts in depth. The reef is very variable in size, but is typically lenticular in cross section.

Output:

	Tons	cwt.		oz.	dwt.	gr.
1898			crushed for	18	0	0 (1)
July, 1899	20	0	,,	59	15	0
March, 1900	118	0	,,	165	0	0
November, 1900	44	0	,,	31	0	0
September, 1901	30	0	,,	34	10	0
August, 1902	17	0	,,	11	12	0
November, 1902	21	0	,,	74	10	0
October, 1903	14	0 (2) (3)	,,	6	4	0
June, 1904	10	10	,,	22	0	0
,, 1904	7	0 (4)	,,	* 2	10	0
,, 1904	5	0 (5)	,,	5	10	0
November, 1904	29	10	,,	75	0	0
December, 1904	6	0 (4)	,,	3	12	0
August, 1905	46	10 (6)	,,	50	18	12
May, 1906	9	0 (7)	,,	3	3	0
Total	377	10	,,	563	4	12

(1) Mr. Webb's estimate of his dollyings from the first 12 ft. of sinking.
(2) Headings. (3) *Fide* Mr. Stuckey, not given by Warden. (4) Seconds.
(5) Trial crushing. (6) Not given by Warden. (7) Stone thrown on tip.

Gold Mount.

This forfeited lease (G.M.L. No. 20) is on a high spur, $\frac{7}{8}$ mile north-north-east of the police reserve.

In the northern part of the lease there are four separate shallow open-cuts on an outcrop of felsite. Gold was found on the surface over a width of 25 ft., chiefly in quartz fragments, and the first work done consisted of sluicing the soil during rainy weather. Quartz leaders were then found ramifying through the felsite, and an attempt was made to exploit the whole deposit, sending the stone down to the battery on pack horses. It was, however, proved that this could not be profitably done, and a proposal was made to erect an aerial ropeway to connect with a tramline at the bottom of the hill, but presumably sufficient work had not been done on the deposit to warrant the expenditure involved.

The occurrence of gold-bearing veins in felsite has been noted at Kilkivan (1) (in Queensland) and at Pambula (2) (in New South Wales).

Output:

May, 1906—2 tons crushed for 2 oz. 8 dwt. (3).

Graveyard.

The Graveyard claim is within $\frac{1}{2}$ mile of the police reserve, on the north-east.

Two shallow underlie shafts have been sunk on the line of strike, and a vertical shaft was put down in the hanging-wall country to a depth of 50 ft.

The country rock is a blue, chloritic, augen-schist, dipping 80° to the west-north-west. The rock here has in fact suffered far greater crushing than anywhere else on the field.

(1) G.S.Q. Publication No. 28. (2) Mineral Resources of N.S.W., p. 63.
(3) *Fide* Mr. Stuckey. Not given by Warden.

The reef, which strikes east and west and dips 80° to the north, is very bunchy in form, varying from nothing to 7 or 8 in. in width, and is also irregular in value. As a whole the stone is said to be very poor, but lumps of quartz are found which run 10 oz. per ton. The quartz at grass is white, and banded with wavy lines of a bluish chloritic material, as at the Boomerang; and a little finely pulverulent, crystallised pyrite is to be seen in drusy cavities in it. The shoot of stone has not been proved over a greater length than 20 ft.

Output:

2 tons crushed for a yield of 2 oz. (1).

(1) *Fide* Mr. Webb.

Hamesly and Quinn.

This reef lies about $\frac{7}{8}$ mile north-north-west of the police reserve, in the triangle between the Starcke United and Starcke Consols leases.

Two shafts 20 ft. apart have been sunk 50 ft., and some trenching has been done $\frac{1}{2}$ ch. to the east.

A vertical reef has been stoped out between the shafts, but only shaly slate country is now exposed.

Output:

November, 1898—3 tons crushed for 5 oz. 6 dwt.

Hit or Miss.

The Hit or Miss (P.A. No. 55) lies in a gully, $\frac{3}{8}$ mile north of the police reserve.

Two shallow shafts have been sunk on an east and west line, and a cutting has followed the leader westwards and round a bend to the south for 30 ft.

The country is fine-grained quartzite, sandstone, micaceous slate, and white quartz-porphyry, the last being in the main shaft.

Output:

	Tons	cwt.		Oz.	dwt.
September, 1899	2	0	crushed for	5	1
November, 1899	2	10	,,	3	9
September, 1904	6	0 (1)	,,	3	3
December, 1904	10	0 (2)	,,	11	18
August, 1905	6	10 (3)	,,	11	0
August, 1906	13	0	,,	7	19
Total	40	0	,,	42	10

(1) Warden gives "sundries." (2) Jephson and Co. (3) Frenchy. *Fide* Mr. Stuckey.

La France.

The La France workings, comprising an adit, open-cut, and shaft, are on the southern part of the Rio Tinto shoot, which is now included in the Starcke Consols lease (q.v.). The adit, 12 ft. in from the surface, meets Albert's underlie shaft, which is 60 ft. deep, and connects with the Rio Tinto adit, above which the ground is in an insecure state.

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Photo., L.C.B.

FIG. 8.—THE LAST HIT NO. 1 SHAFT, AND THE TRIAS-JURA ESCARPMENTS OVERLOOKING THE VALLEY OF THE STARCKE.

There is at grass about 1 cwt. of laminated quartz carrying fine gold.

Output: *See* Rio Tinto.

Last Hit P.C.

The whole of this claim is now included within G.M.L. No. 17, which is itself surrounded by G.M.L. No. 21, and is held by the Starcke United G.M. Co.

There are four shafts: No. 1, now the main engine shaft, is 146 ft. deep; No. 2, the air shaft, is 65 ft. deep and lies 65 ft. east of the first. No. 3 shaft, 5 ch. to the east-south-east of No. 2, is 80 ft. deep; an air shaft is 20 ft. west-north-west of the last; and a duffer shaft lies 2½ ch. west-north-west of No. 3. A descent was made into Nos. 1 and 3, though no work had been carried out in the latter for a considerable period. In the former, however, sinking operations were going on, and a close examination of the whole of the workings connected with the shaft was possible.

At the main shaft is a steam winding engine of 12-h.p., which with 100 gall. buckets formerly kept the mine baled. Latterly, however, a Knowles sinking pump had been in service, and was often kept at its full capacity—3,800 gall. per hour. The water is quite potable, and must therefore be surface drainage. It is in fact believed by the miners to have been drawn from the old Boomerang workings, *viâ* the Ruby United.

The manager informed me that it cost 29s. per ton to mine, raise, and deliver the stone from the Last Hit at Stuckey's Battery. He also stated that the tailings from that battery were worth 16½ dwt. per ton, wherefore, to defray costs (including crushing) and to allow for losses, the stone mined should contain at least 30 dwt. per ton.

The east-west arm of the Last Hit lode, on which is the No. 1 shaft, has a proved extent along the surface of only 3 ch., but one of its branches runs for 3 ch. through the Nos. 1 and 2 W. claims. The No. 3 shaft is on a west-north-west striking reef, which has been followed for 1 ch. towards the No. 1 shaft and for 3½ ch. in the opposite direction. A split occurs in this reef, and a short branch runs out eastward from No. 3 shaft to the deep shaft on No. 1 E. claim.

The coarsest gold from the No. 1 shaft is dark yellow in colour and ragged in texture, and it occurs in laminated quartz containing inclusions of the country rock. Its occurrence is very patchy, much of the stone being barren but giving way quite suddenly to bunches carrying 10 oz. per ton. The stone crushed during the last two years has yielded between 2 and 4 oz. per ton, and considerable care had to be exercised to bring about uniform returns. The stone last crushed comprised dark blue graphitic slate, veined, especially where crushed, with quartz and calcite, the last mineral and the crushed rock containing a little pyrite. Minute crystals of mispickel—elongated prisms, terminated by brachydomes—sometimes in cruciform twins, were also noticed in the crushed rock.

The country rock, at a depth, is bluish tuff, veined with quartz and seamed with thin sheets of calcite.

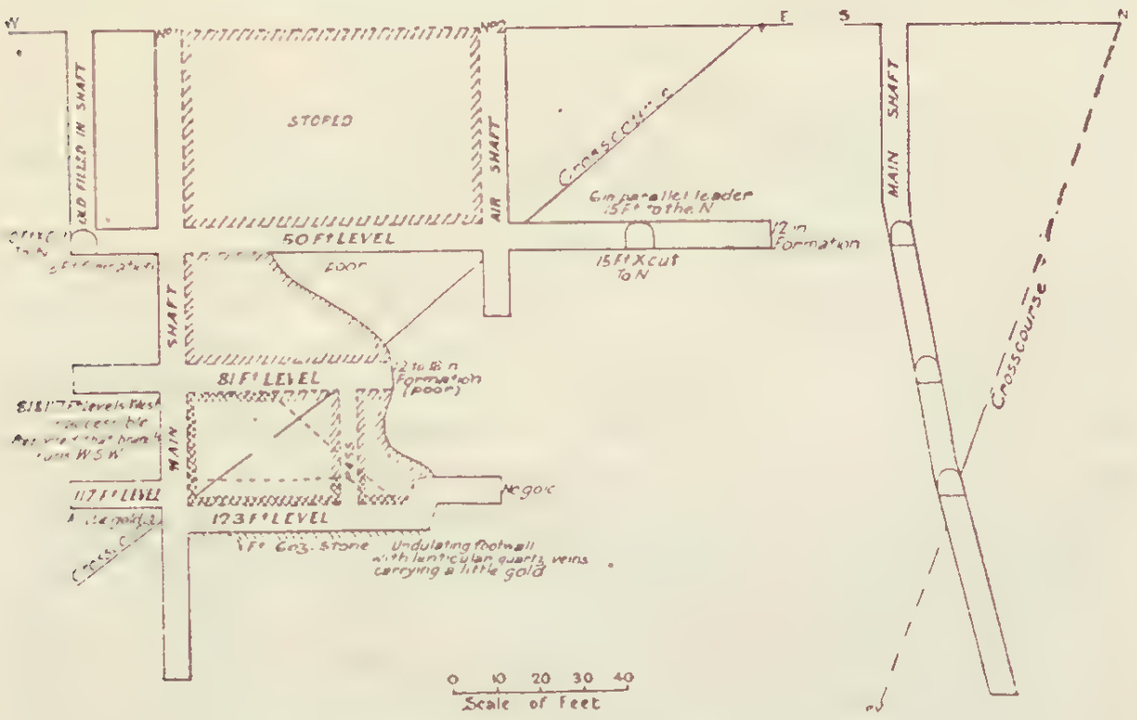

FIG. 9.—SECTIONS ON THE MAIN WORKINGS, LAST HIT.

No. 1 Shaft.—The shaft within the timbers is 3 ft. 3 in. by 9 ft. 9 in. in the vertical part and 3 ft. 6 in. by 8 ft. in the underlie. It is vertical for 40 ft., and then underlies 80° till towards the bottom, where it flattens to 75°.

In the bottom, 140 ft. below the surface, is the "reef," consisting of 8 to 10 in. auriferous quartz-veined formation without defined walls. A parallel formation, 18 in. wide and carrying colours of gold, lies 4 ft. back in the foot-wall. There has been a marked decrease lately in the gold content of the stone raised while sinking, but it was still mixed with stone from the 123-ft. level, this presumably accounting for the low yield in the last crushing. A cross-course dipping 70° to the north-west crosses the shaft at the 123-ft. level, dislocating the reef 3 ft. to the north-east. The cross-course is a water-bearing reef, 4 ft. wide, with well-defined and slickensided walls. It is believed to be poor in gold, but has not been sufficiently tested, although a 2-oz. parcel of stone was broken down from the main reef in its vicinity.

On the 50-ft. level west there is 3 ft. width of formation, but at the eastern end there is only 12 in. width. A parallel leader 6 in. thick was found in the crosscut north; this carried a little gold, but frayed out eastwards within 5 ft.

At the 81-ft. level a shoot of 2-oz. stone, 10 in. in thickness, was struck and worked out. In the eastern face 12 to 18 in. of slickensided, auriferous, quartz-bearing formation can be seen alongside 6 to 18 in. formation, but values are said to be low. The western drive is inaccessible; in it the reef splits, a branch running off to the west-south-west, as on the 117-ft. level west, which is also inaccessible.

Only the last 20 ft. of the 117-ft. level east was accessible; the reef was auriferous to within 5 ft. of the face, where the formation pinched to a foot in thickness and the quartz failed. Quartz is, however, appearing again in the face, and the walls, which are of promising dark-coloured rock, seem to be widening out. It was therefore proposed to continue driving with the idea of ultimately connecting with No. 3 shaft. The reef was 15 in. wide at the shaft, and three heaps of formation at the surface came from this drive. A surface sample was taken from the largest of these, and yields only traces of gold and silver (Government Analyst).

The 123-ft. level is really an underhand stope beneath the 117-ft. drive east. This is on the shoot first struck on the 81-ft. level, which has increased in length here to 56 ft. The formation averages 2 ft. in thickness, and of this 6 to 18 in. is quartz, which the manager affirmed would run 5 or 6 oz. per ton, it being certainly rich in visible gold. At the eastern end of the shoot the included country increases in quantity, and at the same time the gold contents rapidly fall. The full width of quartz-veined formation here is 5 ft., including a 3-in. vein of quartz 18 in. from the foot-wall. The foot-wall is undulating and well defined, but there are lenticular quartz veins carrying a little gold beyond it. The hanging-wall exhibits slickensides pitching steeply towards the east.

No. 2 shaft is now in use as an exhaust for the steam pump, and could therefore not be examined.

The stone from the surface at the No. 3 shaft was dollied in the earlier days of the field by the aid of blackfellows. Some of it carried 100 oz. per ton. This was presumably taken from the cut running for 20 ft. west from the shaft. An examination was made of the 80-ft. level. In the eastern drive, which is 60 ft. long, there is 6 to 12 in. of a soft bluish formation with good walls and occasional bunches of quartz, up to 6 in. across. A stope extends for 8 ft. from the shaft. The western drive, at 35 ft. from the shaft, following the hanging-wall makes a sharp bend to the north-west, its total length being 45 ft. The footwall appears to have been left, so that the drive really becomes a crosscut, and proves a thickness of 10 ft. of formation (quartz-veined pyritous country). Old miners speak of only 6 in. in the centre of the formation having been taken away for crushing. About 20 tons of the formation is stacked at grass, and a surface sample from it has been assayed (Government Analyst):

Gold	8 dwt. per ton.
Silver	2 dwt. per ton.

A stope extends westwards from the shaft for 12 ft., and at the end of it there is 4 ft. width of quartz, with including country, reported to carry 5 dwt. per ton. Mr. Webb, one of the former proprietors, informed me that during sinking the best gold was found at the intersection with three slightly auriferous leaders, which came out of the footwall.

There would seem to be a considerable body of low-grade formation in these workings, which should have been thoroughly sampled by the company, before operations ceased.

Output:

	Tons	cwt.		Oz.	dwt.	gr.
July, 1898	4	5 (1)	crushed for	332	0	0 (2)
August, 1898	15	6 (3)	,,	246	11	0
October, 1898	20	0	,,	204	13	0
November, 1898	20	0	,,	117	12	0
December, 1898	20	0	,,	70	18	6
January, 1899	22	10	,,	25	0	0
February, 1899	35	10	,,	82	4	0
April, 1899	49	10	,,	443	0	0
May, 1899	38	0	,,	232	0	0
July, 1899	4	10	,,	6	10	0
August, 1899	57	0	,,	223	14	0
September, 1899	22	10	,,	40	14	0
December, 1899	106	0 (4)	,,	74	0	0
,,	50	10	,,	202	0	0
May, 1900	72	0	,,	342	0	0
December, 1900	73	0	,,	97	0	0
February, 1901	10	0	,,	6	10	0
August, 1901	50	0	,,	105	17	0
December, 1901	25	10	,,	97	10	0
May, 1902	35	0 (5) (6)	,,	13	0	0
,,	31	0	,,	56	0	0
,,	20	0 (5)	,,	7	17	0
June, 1902	9	0 (7) (8)	,,	4	17	0
July, 1902	12	0	,,	28	10	0
August, 1902	18	0	,,	64	3	0
September, 1902	32	0	,,	13	10	0
,,	36	0 (7) (9)	,,	5	15	0
October, 1902	30	0 (10)	,,	9	8	0
November, 1902	27	10 (11)	,,	75	10	0
December, 1902	59	0 (10)	,,	14	3	0
May, 1903	22	0	,,	32	0	0
,,	12	0 (12)	,,	4	0	0
June, 1904	21	0	,,	52	0	0
November, 1904	10	0	,,	14	14	0
December, 1904	6	0 (8)	,,	2	8	0
November, 1907 (13)	23	0	,,	53	0	0 (13)
March, 1908	25	0	,,	98	0	0
May, 1908	49	0 (15)	,,	181	0	0
June, 1908	46	0	,,	94	0	0
July, 1908	39	0	,,	78	18	0
August, 1908	30	0	,,	69	0	0
October, 1908	50	0	,,	124	0	0
November, 1908	41	0	,,	84	0	0
January, 1909	22	0	,,	21	18	0
Total	1,401	11	,,	4,151	4	6

(1) Dollied. (2) Mr. Webb has returns for 363 oz. dollied by blacks. (3) Cocoa Creek. (4) Mullock (screenings). (5) Headings. (6) *Fide* Mr. Stuckey. Not given by Warden. (7) Seconds. (8) Given by Warden as 29 tons 11 oz. (9) Formation from No. 3 shaft. (10) Surface. (11) Warden gives 21 tons 10 cwt. (12) Gains and party (headings). (13) This and the following returns are from the main shaft, Starcke United. (14) From east stope at 80-ft. level. Crushed at Charters Towers, where the tailings were sold for 10s. 6d. per ton, making the total value of the crushing £9 12s. 10d. per ton. (15) Underhand stoping, 115-ft. level.

Last Hit No. 1 W.

The surface rubble, shed over an area a chain in diameter, from the continuation of the P.C. line, has been removed and crushed; besides which two shafts were sunk, one on the main line, where a west-south-west branch leaves it (about a chain west of the P.C. No. 1 shaft) and a second $\frac{2}{3}$ ch. to the west-south-west. Both have been filled in, but the latter is said to be 40 ft. deep. When the claim was first taken up three men were kept at work dollying, the average result per week being 30 oz. of gold.

Output:

	Tons cwt.		Oz. dwt. gr.
July, 1898	...	crushed for	120 0 0 (1)
October, 1898	20 0	,,	22 17 0
November, 1898	4 10 (2)	,,	3 12 0
December, 1898	20 0	,,	30 10 12
March, 1899	6 0	,,	4 3 7
July, 1899	14 10	,,	62 13 0
September, 1899	21 0	,,	19 11 6
October, 1899	75 0 (3)	,,	22 8 0
,, ...	60 0 (3)	,,	12 2 0
December, 1899	53 0	,,	11 9 0
March, 1900	200 0 (3)	,,	50 18 12
June, 1900	23 0 (3) (4)	,,	2 0 0
February, 1901	15 0	,,	18 0 0
March, 1903	4 0 (5)	,,	3 0 0
August, 1904	30 0 (6) (7)	,,	5 0 0
Total	546 0	,,	388 4 13

(1) Dollyings, *fide* Mr. Webb. (2) Warden "F. Quin." (3) Surface.
(4) *Fide* Mr. Stuckey. Not given by Warden. (5) Given by Warden as No. 1 E.
(6) Headings. (7) Warden gives 1 ton 10 cwt. for 5 oz.

Last Hit No. 2 W.

Two shafts, about 20 ft. apart and 50 ft. deep, have been sunk $2\frac{1}{2}$ ch. west-south-west of the P.C. No. 1 shaft, but have both fallen in. It is stated that much driving was fruitlessly carried out here in search of the golden shoot, and besides much trenching has been done on the surface.

Output (1):

	Tons cwt.		Oz dwt. g.
November, 1902	6 0	crushed for	4 16 0
December, 1902	10 10	,,	35 7 0
,, ...	10 0 (2) (3)	,,	0 17 0
May, 1903	8 10 (4)	,,	5 0 0
October, 1903	2 0	,,	15 4 0
December, 1903	1 15	,,	3 2 0
January, 1904	20 0 (5)		2 10 0
Total	58 15	,,	66 16 0

(1) No dollyings. (2) Surface. (3) *Fide* Mr. Stuckey. Not given by Warden.
(4) Seconds. (5) Headings.

Last Hit No. 3 W.

The return given below was reported to the Warden, but it is now not possible to locate the spot from which the stone was taken.

Output:

May, 1903—4 tons crushed for 4 oz. 16 dwt.

Last Hit No. 1 E.

A shaft has been sunk to 70 ft. below the surface on the east-west line proved by the No. 3 shaft of the P.C. At the bottom there is said to be a 3-in. leader carrying about ½ oz. gold per ton, but richer stone obtained above is believed to have been crushed with parcels from the P.C.

Output (1):

November, 1902—3 tons crushed for 3 oz.

(1) No dollyings.

Lily of the Valley.

The Lily of the Valley lies 1 mile north by east of the police reserve, and just to the north of the Duke of York lease.

The workings comprise two shafts, 25 ft. deep and ½ ch. apart, and an adit from the gully side, besides a large number of trenches and potholes.

Five separate shoots or pipes of gold-bearing stone have been found on this ground, within a distance of 2 ch., along the Duke of York porphyry. The gold occurs in quartz leaders on both sides, or either side of the dyke, but never in the rock itself, though the auriferous bunches on opposite sides are often connected by black seams. The country rock—a dark schistose slate near the porphyry—has been seamed with quartz, sometimes over a width of 2 ft., and is then known as "formation."

Output:

	Oz.	dwt.
1898—Dollied from surface stone (1)	70	0
October, 1899—4 tons crushed for	2	5
Total	72	5

(1) *Fide* Mr. Webb.

Lizzie Trembles.

The Lizzie Trembles leader crosses a belt of porphyry, about 10 ch. west-south-west of the Gold Mount workings.

Output:

July, 1899—2 tons crushed for 5 oz. 3 dwt.

Love's Duffer.

Love's Duffer workings are about 5 ch. north of the north-eastern corner of the Starcke Consols lease. Traces of gold are said to have been got on the surface; but a shaft, sunk 25 ft. in horny, bluish, silicified slate, failed to locate a reef.

Monte Carlo.

The Monte Carlo workings, formerly known as the Sea View, lie on the seaward side of the range, ¼ mile north of the Gladstone.

The workings are all now in a dilapidated state. The main or eastern, shaft is 55 ft. deep; the central shaft, 30 ft. to the west, is 30 ft. deep; and the western shaft, 45 ft. to the west of that, is 20 ft. deep. Some driving has been done from the main shaft and from the central, and there is a long trench adjacent to the western shaft.

Nothing definite can be made out of the reef, but in the western trench there were probably a number of bunches of quartz not more than 6 in. thick at most. The quartz here is rather more crystalline than usual, and emits, when broken, a strong odour of sulphuretted hydrogen. The quartz in the other tips is white, granular, and contains much partly replaced country. That from the deeper workings is bluish, and contains a little very finely disseminated pyrite. The country is a massive, micaceous, tuffaceous, and slightly schistose rock, tilted at a high angle to the west.

As showing the disadvantages under which the mine was worked it may be mentioned that cartage to the mill cost 10s. and crushing 25s. per ton.

Output:

	Tons cwt.		Oz. dwt. gr.
, 1898	...	crushed for	40 0 0 (1)
July, 1898	12 0	,,	18 12 0
November, 1898	12 15	,,	66 0 15
August, 1899	125 0	,,	164 0 0
October, 1899	36 0	,,	24 10 0
February, 1902	7 10	,,	6 18 0
April, 1902...	12 0	,,	4 0 0
January, 1903	14 0 (2)	,,	3 9 0
July, 1903	20 0	,,	6 0 0
September, 1903	8 0 (2) (3)	,,	5 10 0
October, 1903	20 0	,,	5 10 0
Total	267 5	,,	344 9 15 (4)

(1) Mr. Webb's estimate of his crushings from the Sea View. (2) Headings. (3) Warden gives 15 tons. (4) The value of the Monte Carlo gold was usually 1s. per oz. greater than that from the other mines of the field.

Mountain Maid.

The Mountain Maid workings are near the cap of a high spur about 10 ch. north-north-east of the Duke of York lease.

The reef, which has a width of up to 9 in., dips 45° to the south-south-east. A shoot 20 ft. in length was located and two shafts, a vertical and an underlie, were sunk on it to a depth of 20 ft. Then an adit known as Besanti's was put in 100 ft. from the ridge side and drives were carried 10 ft. east and 30 ft. west from the end of it, along a leader of quartz up to 6 in. in thickness. Very rich dollying stone was obtained at the surface but deterioration appears

to have been rapid as the depth increased. The adit at the entrance is in slate but the country adjacent to the reef is a micaceous tuff.

Output:

	Oz.	dwt.
1898—Stone dollied for	50	0 (1)
1899—Stone dollied for	25	0 (1)
March, 1899—5 tons (2) crushed for	6	8
Total	81	8

(1) *Fide* Mr. Webb. (2) Seconds from dollying.

Old Starcke Leaders.

When the exodus began to set in on the Old Starcke alluvial field, at the head of the Diggings Creek, an attempt was made by Mr. Dick's co-operative party to test a number of leaders, which had been located about a mile south-east of Mount Hetty and 5½ miles east-by-south from Munburra. The main leaders were three in number, about 10 ft. apart and ran north-east in quartz-felsite country, much kaolinised near the surface and not free from a north-north-east trending schistosity. The first work consisted in the excavation of a number of open-cuts, in which nothing can now be seen of the leaders.

Mr. Webb has records of 125 oz. of gold dollied from the surface stone; and gold-bearing specimens, shown me by him as from the leaders, indicate a high degree of similarity in the vein fillings here and in the vicinity of Munburra.

The co-operative tunnels or, more properly speaking, adits were put in from the creek level, within a chain to the south of the old surface workings. They have now caved-in but are said to be between 70 and 100 ft. long. Old prospectors state that the leaders came together within 20 ft. of the surface and their metal contents rapidly fell off, and that the gold obtained in driving the adits was a negligible quantity.

Poor Old Torres.

The Poor Old Torres claim (No. 105) is in the south-western corner of the Starcke Consols lease. An adit, 35 ft. long, intersects one of Weir's underlie shafts, which was continued for 40 ft. with Government aid. This shaft is now full of water, and a drive to the east on the adit level has been blocked up with mullock.

In the adit the reef is only 2 to 3 in. thick, with a well defined foot-wall and 3 or 4 in. of quartz-bearing formation on the hanging-wall. The quartz is creamy white, and exhibits thin lines of pyritous country.

Output:

September, 1902—7 tons 10 cwt. (1) crushed for 2 oz. 6 dwt.

(1) The Warden's return is 7 tons, raised by Rapport and Robbins.

Queen Alexandra.

The Queen Alexandra reef strikes along the southern boundary of the Boomerang United, one of the leases of the Starcke United Company. Outside of forfeited lease No 10, it is known as the Edna, and as such has been described above.

The main underlie shaft on the reef is 80 ft. in total depth. This appears to be in a safe condition, but a descent could not be made because of the ladders having been removed. Mr. Webb states that at the 80-ft. level there are prospecting drives for 50 ft. east and 50 ft. west, and at the 50-ft. level there are drives for 80 ft. east and 40 ft. west; and that above the 50-ft. level some stoping has been done.

The dip of the reef is usually about 45 degrees northwards, but the strike varies between west-north-west and north-west. The quartz at grass is crystalline, banded in parts, and contains flakes and seams of dark mineral residual from inclusions of country. There are traces of galena in the quartz, which, with the greenish sulphurous oxidation stains, is looked upon as the best indication of the presence of gold. Beside the reef itself there must be some width of formation. The country at the surface is light coloured arenaceous tuff (?), but at a depth changes to dark blue and becomes pyritous. It is much slickensided internally. Porphyry must also have been met in some of the underground workings.

Output:

	Tons cwt.		Oz. dwt.
May, 1903	8 5	crushed for	40 12
July, 1903	10 0 (1)	,,	5 10
August, 1903	31 0	,,	67 0 (2)
October, 1903	20 10 (3)	,,	35 19
December, 1903	17 0	,,	42 10
August, 1904	3 0	,,	3 0
Total	89 15 (4)	,,	194 11 (4)

(1) Seconds. (2) Warden gives 65 oz. 16 dwt. (3) *Fide* Mr. Stuckey. Not given by Warden. (4) Total given as 152 tons crushed for 296 oz. 1 dwt.

Rapport.

Rapport's porphyry shaft lies 2 ch. south of the south-eastern corner peg of G.M.L. No. 17 and is now within the Starcke United Company's lease. It has been filled in and nothing can be seen of the leader worked, but the country rock is a white, almost fissile, porphyry, belonging to the main belt found at intervals through the whole of the property.

Output (1):

2 tons crushed for ½ oz.

(1) Local report.

Reine d'Or.

The Reine d'Or is located near the crest of a sharp spur, ½ mile north-east-by-north from the police reserve. A 10-ft. pothole and a pit have been sunk on a few east-west ferruginous stringers in arenaceous and micaceous, well-bedded, tuff. There are also trenches on a leader running north-west, 10 ch. to the south-west of these workings. A little gold is said to have been got here by dollying.

Rio Tinto.

The Rio Tinto shoot, which has been worked over a distance of nearly 2 ch., occurs in the centre of the Starcke Consols lease. The southern part of the shoot is sometimes referred to as the La France, a claim on it having been so named.

Nelson's shaft at the northern end is inaccessible, but some particulars are available as to Albert's shaft at the southern end. (*See* Starcke Consols.)

Output:

	Tons	cwt.		Oz.	dwt.	gr.
December, 1898 (1)	5	0	crushed for	16	5	12
May, 1898	23	0	,,	73	14	6
August, 1899	20	0	,,	54	4	0
September, 1899	3	0	,,	3	12	10
November, 1899	50	0	,,	109	7	0
April, 1900	3	0	,,	2	4	0
August, 1901	27	0	,,	15	15	0
November, 1901	7	0 (2)	,,	10	9	0
December, 1903	6	5	,,	20	6	0
August, 1904	8	0 (3)	,,	20	10	0
November, 1904	5	0	,,	9	2	0
December, 1904	5	0	,,	6	18	0
Total	162	5	,,	342	7	6

(1) Much stone dollied, but no records. (2) Given by Warden as La France.
(3) Mr. Stuckey says La France.

Rio Tinto No. 1 N.

The return given below probably should be attributed to the open-cut at Nelson's shaft.

Output:

	Tons	cwt.		Oz.	dwt.	gr.
June, 1898	4	10	crushed for	5	15	12

Rio Tinto No. 2 S.

(*See* Weir's.)

Ruby United.

The Ruby United workings extend along the western side of the Starcke United Company's lease No 21, over a distance of 7 ch. The southern end of the reef was worked by the Boomerang No. 1 W. and is described under that heading.

In the north-western workings there was about a foot of crushing stone, but at 50-ft. depth in the inaccessible main shaft there is said to have been between 2 and 3 ft. width of quartz. The country rock is a micaceous sandstone and altered shale striking north 15 degrees east.

Output:

	Tons.		Oz. dwt.
, 1898	4 (1)	crushed for	8 0
May, 1900	11 (2)	,,	4 9
Total	15	,,	12 9

(1) *Fide* Mr. Starcke. ( ) Test parcel from north-western workings.

St. Patrick.

The St. Patrick workings are in a gully in the northern part of the Starcke Consols lease beyond the Rio Tinto, but apparently on the same line.

Four shafts have been sunk to a depth of about 60 ft.: one, 3½ ch. north of the Rio Tinto adit, struck heavy water; a second is 2 ch. further north; and ½ ch. beyond are two others 15 ft. apart. Ground has been stoped out between the last two and caving has since taken place, exposing between 2 and 3 ft. width of formation, with well defined slickensided hanging wall. The quartz raised and still at grass is white and crystalline or in places crystallised, and shows lines of included country. Oxidation stains indicate the presence of mispickel in the reef here. The country from a depth is a bluish, quartz-veined, crushed rock, but at the surface is an arenaceous schist.

The formation in the next shaft to the south is up to 5 ft. wide, with a leader on the footwall diping 45° to the west. Some stoping was done in this shaft below the 25-ft. level. The comparatively great thickness of formation met here encouraged the prospectors to have a trial crushing of 10 tons, which is said to have yielded 7 dwt. per ton.

Output:

	Tons cwt.		Oz. dwt.
October, 1899	28 0	crushed for	85 0
October, 1900	11 10 (1)	,,	3 0
November, 1900	48 10	,,	62 10
January, 1901	21 10	,,	64 10
Total	109 10	,,	215 0

(1) Seconds.

Sea View.

(*See* Monte Carlo.)

Slattery's.

Slattery's P.A. No. 50 was located in the southern part of what is now the Starcke Consols lease.

The two shafts, which were sunk about 30 ft. on the underlie and which are ½ ch. apart, have now fallen in, but it is understood that the reef worked was 7 or 8 in. thick; it was well defined and dipped 45° to the south-west, while the country has a north

and south strike, with a dip of 90°. The shoot must have been a very short one for trenches to the south-east failed to locate pay ore; and further the gold cut out within 30 ft. of the surface.

Output:

July, 1899—8 tons (1) crushed for 19 oz. 6 dwt.

(1) P.A. No. 50.

Starcke Consols.

The Starcke Consols is a lease (G.M.L. No. 23) of 28½ ac., lying a little less than ¾ mile north of the police reserve. This lease includes within its boundaries the following workings and claims: Dyer's, St. Patrick, Rio Tinto (and La France), Weir's, Slattery's, and Poor Old Torres—all elsewhere described.

The shoots of auriferous stone on all of these (except Dyer's) are connected with a north-south belt of porphyry; and a peculiar and unusual feature is that the best gold is found where the reef is thickest.

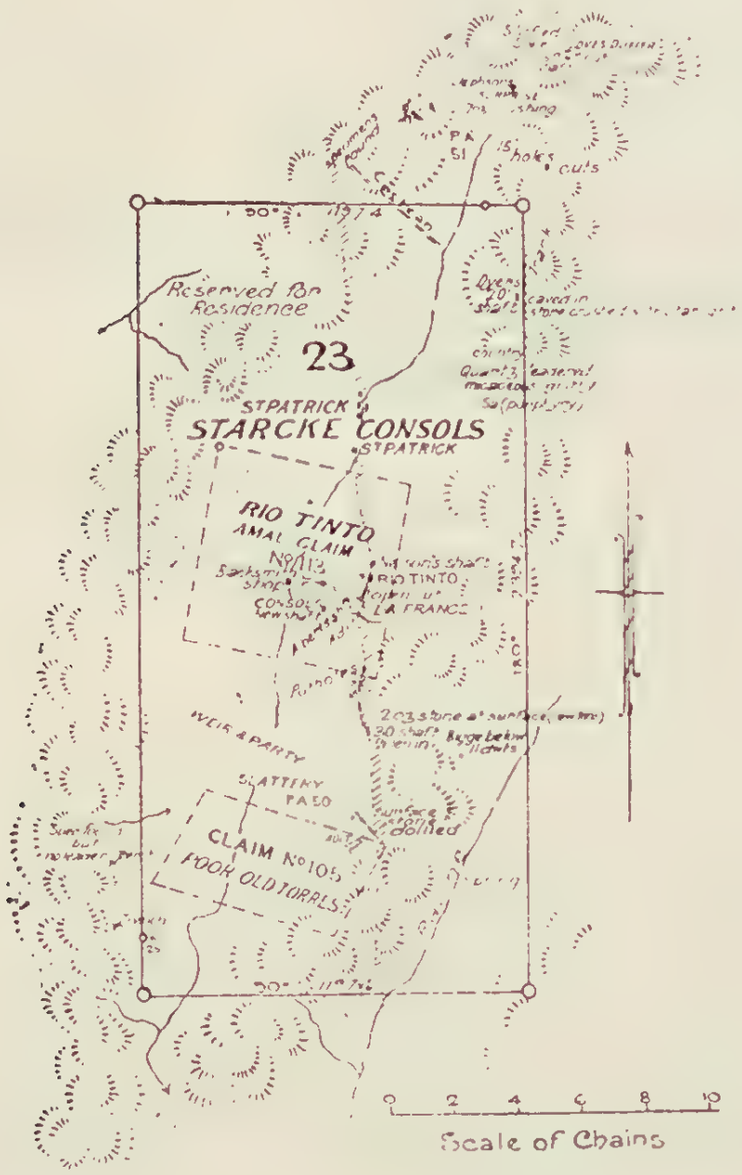

FIG. 11.—PLAN STARCKE CONSOLS.

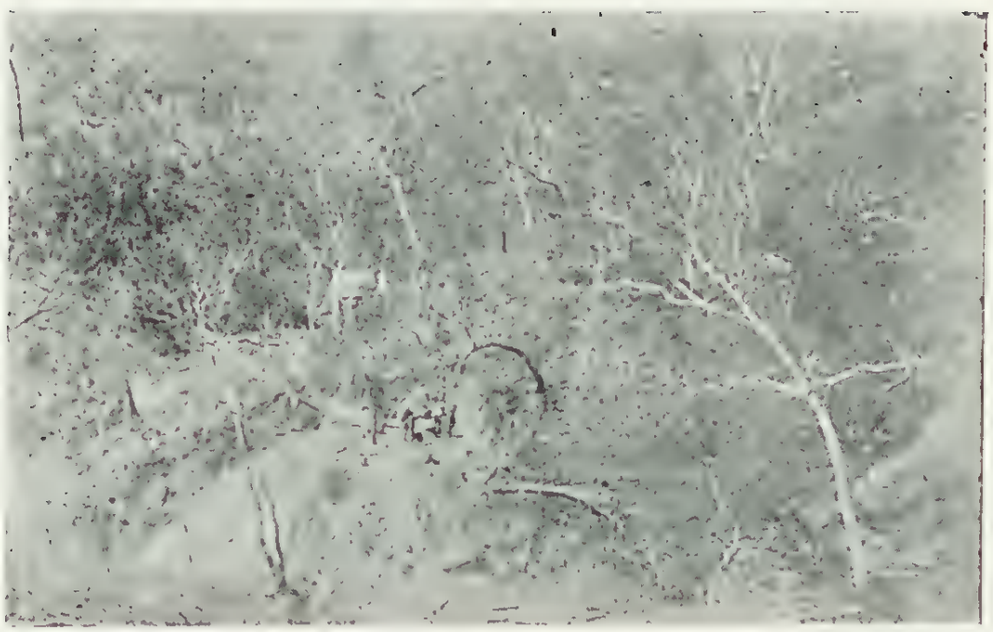

Photo., L.C.B.

FIG. 10.—THE STARCKE CONSOLS VERTICAL SHAFT AND THE MOUTH OF THE RIO TINTO ADIT (IN THE GULLY BEHIND).

been worked out to within 20 ft. of the level, where it should intersect the formation. The only use that can be made of this shaft now is to sink it to the foot-wall of the reef and then drive to the north. Having decided on sinking a vertical shaft, although an underlie is always preferable for prospecting, a little consideration would have shown the advisability of deciding on a site across the creek to the west of the blacksmith's shop.

Output (1): For early returns *see* La France and Rio Tinto, Poor Old Torres, St. Patrick, Slattery's, and Weir's.

March, 1908—69 tons 10 cwt. crushed for 125 oz: £4 per oz.

(1) *File* Mr. Stuckey.

Starcke United.

The Starcke United Gold Mining Company was floated in July, 1907, the total number of shares being 70,000, each of a nominal value of 2s. 6d., and of these 3s. 7d. are paid up. It holds three leases (G.M.Ls. Nos. 17, 21 and 24) aggregating 30½ ac. and lying 50 ch. north-north-west of the Munburra police reserve.

The greater number of workings are on the Boomerang United lease, but the deepest shaft and the latest worked is on the Last Hit. The Starcke King lease was taken up chiefly to obtain control of the country between these leases and includes the greater part of the forfeited leases known as the Queen Alexandra and the Edna.

At least 15 distinct veins or branches have been worked at one time or other to a greater or less extent; but only four of them—the Last Hit, Ruby United, Boomerang, and Queen Alexandra—are of any importance, and these have been described under their respective headings.

The company at the time of my visit was sinking on the Last Hit, but operations have, since January, 1909, been suspended owing to disputes between Cooktown and Gympie shareholders, bringing about frequent changes of management. The capitalisation leaves no margin in case of unremunerative work having to be carried out. There is little doubt that, had the ground been held by one company from the start, active operations would now have been the order of the day, provided that reserves had been laid aside out of profits. It will be quite another matter for a company to begin operations now, in face of the doubt as to the tenor of the stone in the lower workings and the insecure state of the working places themselves.

The Starcke United Company has, however, proved on the Last Hit P.C. the existence of a shoot of payably auriferous quartz 50 ft. in length, extending to a depth of at least 125 ft. It is quite reasonable to suppose that, had the company undertaken work on the Last Hit No. 1 E., the Boomerang and the Queen Alexandra, other

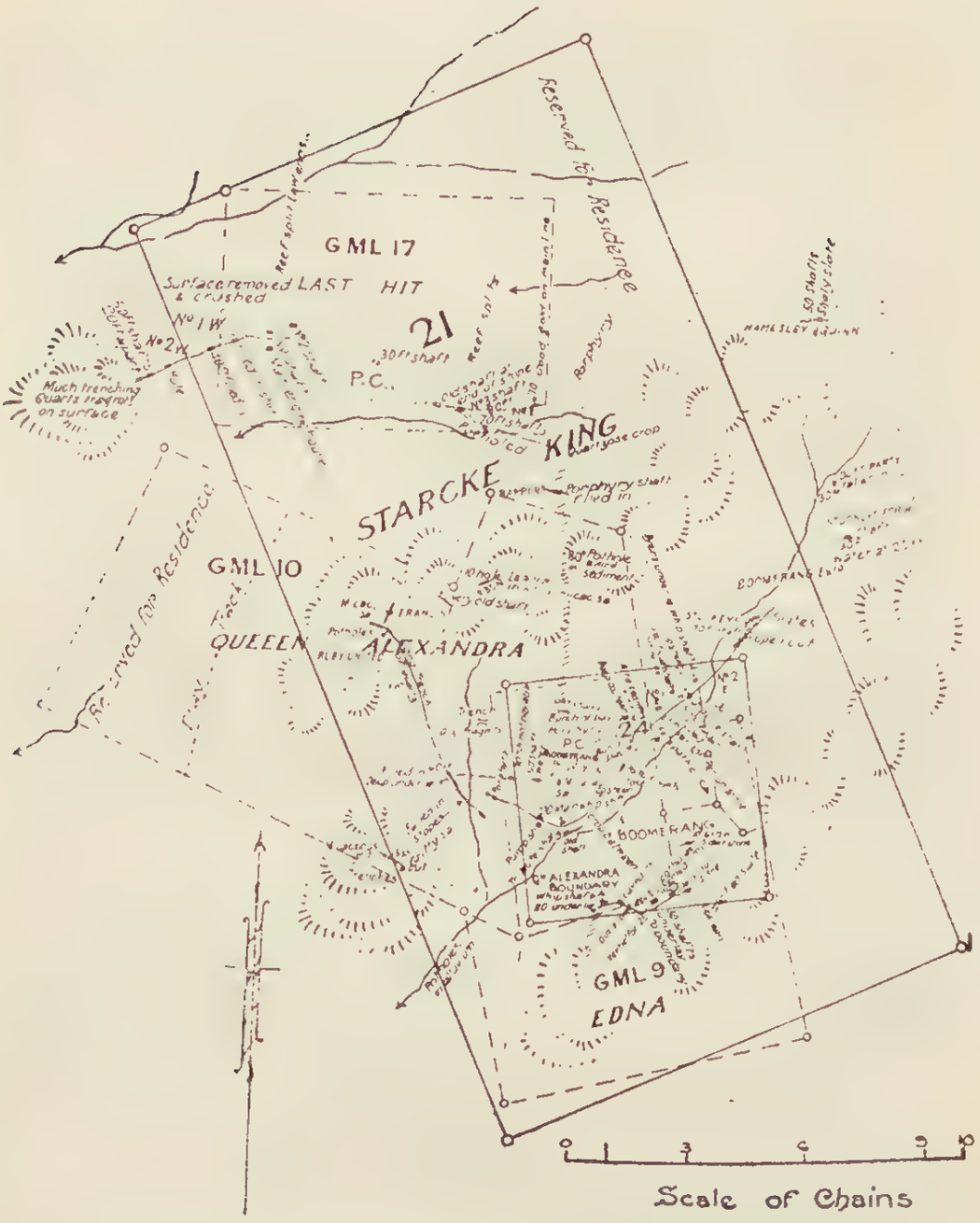

Fig. 13.—Plan Starcke United, with Leucophyre and Tuff Belt.

payable shoots would have been located, for it is most unlikely that such very rich stone, as was there won on the surface, would become almost barren within 100 ft. of the surface. The surface indications at any rate warrant some prospecting being carried out on these lines below the old workings before abandoning the property. The company is unfortunate in not possessing a battery, yet I should not care to advise that one be purchased until a certain ore-reserve has been proved. Stuckey's battery was held by the company under lease during the greater part of 1908 and is sufficient for the testing of the stone raised, provided that sampling and assaying are carried on in conjunction with crushing.

Output: *See* Boomerang, Edna, Francis, Last Hit, Queen Alexandra, Rapport, and Ruby United.

Starlight Gully.

Dyer sank a shaft in Starlight Gully about 15 ch. north-north-east of the Starcke Consols lease and is said to have raised about 10 tons of quartz for a very disappointing return.

Slattery's adit on P.A. No. 53 is about ¼ mile north of the same lease.

Output (1):

	Tons cwt.		Oz. dwt.
October, 1899	4 0	crushed for	1 10
November, 1899	4 5	,,	4 5½
Total	8 5	,,	5 15½

(1) P.A. 53, and possibly including stone from Dyer's.

Surprise.

Jephson's Surprise (P.A. No. 51) is only about 4 ch. north of the Consols. The leader strikes east-north-east and is practically vertical, whereas the strike of the country is north and south. The main shaft is over 40 ft. deep and is now holding water. Near the top of it can be seen 3 in. quartz but below there is a total width of 15 in. quartz and formation. This has been trenched for 15 ft. to the west-south-west, beyond which it split up into stringers. Some underhand stoping has been carried out, about 20 ft. to the east-north-east of the shaft, but no defined reef can be seen there.

Output:

	Tons cwt.		Oz. dwt.
June, 1899	15 0	crushed for	104 5½
September, 1899	1 10	,,	1 1
April, 1900	4 0	,,	3 17
Total	20 10	,,	109 3½

Tucker's.

Tucker's lies about 3 miles north-west of Munburra, on a low gravelly ridge, on the surface of which several small rich specimens have been found, within an area 3 ch. in diameter.

One shaft was sunk to a depth of 40 ft. and another 2½ ch. to the east-north-east is 20 ft. deep. There are a great number of costeans and trenches between these shafts and beyond them, but no defined run of stone has been located. It is probable that the gold-bearing quartz occurs as small bunchy leaders. The country rock is a micaceous sandstone or tuff striking north-north-east.

Output:

March, 1899—3 tons crushed for 3 oz. 16 dwt.

Uncle Sandy.

Uncle Sandy (forfeited M.L. No. 132 of 5 ac.) lies in the dense scrub 2½ miles east-south-east of Munburra.

An old shaft has fallen in but the top of the stope can be inspected. The lode, which comprise 6 in. of quartz-bearing formation between good walls (clayey iron-stained country), runs east and west, dipping 85° to the south. An adit ½ ch. to the west was continued 30 ft. beyond the shaft but has now caved-in. It is said that a winze was sunk 10 or 12 ft. from the end of the adit and that some stoping was done above it.

The mine was worked for gold but, the ore containing some antimony, it was re-opened by an English firm some years ago and a few tons were shipped for experimental purposes but nothing further was done. A few specimens containing stibnite are obtainable on the tip but the greater part of the sulphide had been changed into valentinite. It is, however, acknowledged by the prospectors connected with the opening of the mine that the percentage of antimony is low.

Output:

	Tons.		Oz. dwt.
October, 1899	4	crushed for	4 0
January, 1900	12 (1)	,,	5 7
January, 1906	9 shipped contained 9 per cent. (2) antimony.		

(1) Picked stone freed from antimony ore. (2) *Fide* Mr. Webb.

Weir's.

Weirs, or the Rio Tinto No. 2 S., workings are on the ridge 2 ch. south of the La France adit (*see* Starcke Consols). They comprise a number of caved-in potholes and shafts, one of which was 30 ft. deep. A small quantity of rich stone was found along the surface—the shoot having a length of at least 2 ch.—but below the reef increased greatly in width and the values fell to 11 dwt.

Output:

	Tons cwt.		Oz. dwt.
September, 1899	3 0 (1)	crushed for	11 7
June, 1899	2 12 (2)	,,	5 5
Total	5 12	,,	16 12

(1) Rio Tinto No. 2 S. (2) Weir's.

1st May, 1909.

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(B. DUNSTAN, F.G.S., GOVERNMENT GEOLOGIST.)

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THE CHARTERS TOWERS GOLDFIELD.

NOTES ON THE MAIN REEFS.

WITH SIX PLATES.

BY

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ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE:

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1909.

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BRILLIANT EXTENDED MINE.

SHOWING AERIAL TRAMWAY FOR TRANSPORTATION OF ORE TO BATTERY.

THE CHARTERS TOWERS GOLDFIELD.

NOTES ON THE MAIN REEFS.

I.—GEOLOGY.

Previous Descriptions.

The geology of the reef systems of the Charters Towers Field has never been described in any detail, and the briefness of my visit, together with the fact that attention had to be paid mainly to the question of the requests for assistance from a number of individual mines, did not allow of more than a very cursory view being taken of the geological structure of the field.

The main gold-bearing reefs lie within an area some 2½ miles in length in an east and west direction by about a mile in width in a north and south direction, the chief producers having a more or less east and west strike and northerly dip.

The general geological features of the field were described by W. H. Rands and A. Gibb Maitland (then members of the geological survey staff) in the Annual Report of the Geological Survey for the year 1892. No geological work has been done on the field since their visit, and as their descriptions of the main outlines of its geology are not easily accessible, they are given here in full.

Mr. Rands thus describes the features of the western portion of the field:—

> The portion of the field on which I was specially engaged lies to the west of a line, drawn in a north and south direction, through the Racecourse.
>
> The greater part of this area is composed of the ordinary granite of the field, a rock which, in places, passes insensibly into a coarse diorite; this feature is more noticeable on the eastern end of the field.
>
> The granite is hornblendic, and contains very little mica. Neither this, nor any of the other rocks of the field, has yet been petrologically examined. This will be done, and the results will be published in a final report.
>
> The granite is intersected by two classes of dykes; one composed of basic and the other of acidic rocks.
>
> The majority of the basic dykes on the western portion of the field have a general bearing of about north-east and south-west, or at right angles to the general bearing of those on the eastern portion. Some of these are very persistent. I traced two parallel dykes for a distance of over one and a-half miles, and they probably extend much further, as towards the south-west I ceased to trace them on coming to the boundary of the map, while to the north-east they were lost on getting among the town blocks, where naturally much of the surface is made-ground. Others could be traced for a mile in length.

Another series of these basic dykes runs in a more or less northerly direction. The only evidence bearing on the relative ages of these two series of dykes is that in the grounds of the Girls' State School, on the East Mexican lease, where a north and south dyke faults two other dykes running in a north-easterly direction. It is probable, therefore, that the whole of these north and south dykes are the more recent.

There is an instance, near "Matlock," where one of the acidic dykes intersects a mass of diorite, and is itself intersected by a diorite, showing that diorites of two distinct periods occur on the field.

The dykes are often lost at the surface for some distance, and then crop up again in the same line, so as to suggest that the dykes are continuous. Where this has occurred, their probable continuation is shown on the map in broken lines.

The composition of these dykes varies considerably; but, pending a more minute petrological examination, they are classed together on the map, and distinguished by the letter *d*.

The acidic dykes consist chiefly of granite and felsitic rocks. The granite is very felspathic, and often contains large blebs of quartz and white mica, with little or no horneblende. These dykes are not so persistent in length as the basic dykes, and are very much more branched and irregular in shape. The longest distance I could trace one of these was about a quarter of a mile. They have no regular bearing, but run through the granite in all directions.

The acidic dykes are, in all cases on the western portion of the field, intersected by the basic dykes, and are consequently of an earlier date than the latter. They are coloured red on the map, and distinguished by the letters *g* and *f*. Some altered igneous rocks, of a serpentinous character, occur near the north-west part of the Public Park Reserve. Dykes of much altered igneous rocks occur in various parts of the field. These rocks are distinguished on the map by a blue colour, and the symbol *n*.

There is a large area of granite between the eastern and western series of dykes, which, so far as can be gathered from the surface indications, is practically free from dykes. In this area are situated some of the richest mines, such as the Brilliant, Victory, Victoria, &c. The underground work may of course prove the existence of dykes here, that are not seen at the surface; and it is impossible, until that work is done, to say what effect, if any, the dykes have on the auriferous character of the reefs.

On the north-western portion of the field there is a large wedge-shaped mass of slates, which dip steeply in a north-easterly direction. These slates run out to a point near Boundary street, just north of the Hospital grounds. These are the oldest rocks on the western portion of the field. The quartz-schists, on the eastern portion, are probably older; but without a more extended survey, it would be impossible to speak with certainty. These beds consist of mica-slates, with layers of quartzite, and a few patches of limestone. The limestone is highly crystalline, and is, in parts, coloured brown with oxide of iron. In the three places where it occurs, the limestone is right in the midst of a diorite, which is intrusive in these sedimentary rocks. A small tongue of diorite in one place cuts into the limestone, showing that the diorite must be intrusive in it, and that the limestone is not a vein.

Dykes of diorite run out from the larger masses into the slates in a south-easterly direction, following, for the most part, the line of strike of the slates, but often cutting across the direction of strike.

Another mass of slates, of similar character, occurs near the south-west corner of the Racecourse Reserve; they continue across the railway line down as far as the Queen's Consolidated and the United Queen's Consols leases. These slates are also intersected by dykes, generally running parallel to the direction of the strike of the beds.

A third very small patch of slates, which are highly micaceous, occurs close to the Rainbow road, on Lease No. 1229.

Some large alluvial flats occur in places along the watercourses.

Mr. Maitland thus describes the eastern portion of the field—

The portion of the field which had been allotted to me may be defined roughly as that district lying to the east of a line running north and south, commencing from the western corner of the Racecourse, and bounded on the east by the waters of Gladstone Creek.

The mapping of this portion of the goldfield turned out to be much more difficult than had been anticipated, owing to the complexity of the geological structure. This work occupied me until January of the present year.

As the Report and accompanying maps have not yet been published, the following is a *résumé* of the geological structure of the portion of the field which fell to my share:—

By far the larger portion of the ground is composed of granite, and a very coarse-grained rock, containing hornblende, mica, and a triclinic felspar—a quartz-diorite. It was found quite impossible to draw any line separating these two distinct rocks. Hence both have been delineated on the map by the same colour and symbol. An examination, yet to be undertaken, of the geological structure as revealed by mining operations, may yield valuable information as to the relation which the granite and coarse diorite bear to one another. In the absence of chemical analysis and microscopic examination, no further details can at present be given regarding these rocks.

The granite penetrates those sedimentary beds which form the lesser portion of the ground.

The sedimentary rocks consist, for the most part, of indurated siliceous rocks (approaching very closely to quartzites), sometimes very micaceous. Wherever they are exposed, the beds are seen to be either vertical or inclined at high angles.

In these indurated sedimentary rocks, in the vicinity of the area which I mapped, the alteration has not proceeded so far as to cause the rocks to be placed in the category of the metamorphic, using this latter term in its strictest sense.

The contrary appears to be the case with the quartzites or quartz-schists, which occupy only a very small portion of the western end of the country in the vicinity of Gladstone Creek. These rocks are distinctly marked off from the rest of the beds, not only by the extent to which alteration has been carried and the physical characters of the rocks themselves, but also by the fact that similar rocks are seen to be interbedded with the chief masses of sedimentary rocks.

These siliceous rocks may be merely part of the sedimentary series of other portions of the field, or they may be of older date. Detailed mapping, carried over a much larger area, is the only method by which the true relation of the two series can be made out.

The area in the vicinity of Gladstone Creek is the only part of the field embraced within the limits of the survey in which these presumably more ancient rocks have been detected.

The most important feature in the structural geology is the system of dykes which occupy a very large area in the eastern portion of the district, and extend to the south-east into country far beyond that which it was my duty to map.

On petrographical grounds, the dykes are divisible into two totally distinct series—a basic and an acidic.

The basic dykes are remarkable from the fact that, so far as it was possible to carry my survey, they had no apparent connection with any visible deep-seated mass of rock of similar composition, unless some relation exists between the coarse diorite and the dykes. This, however, is a subject upon which light may be thrown when the underground survey of the field has been carried out.

The longest dyke has been followed north-west for a distance of about three-quarters of a mile as far as Gladstone Creek, after crossing which it stretches away beyond the limits of the country examined.

When the positions of the various dykes are laid down upon a map, it is found that there are two distinct sets or systems, each approximately at right angles to the other. The individual dykes of each set have an approximate parallel trend.

The rocks of which these dykes are composed are all basic compounds. They vary very much in texture in different parts of the area, and even in different portions of the same dyke. At one end of the series are rocks of very fine grain, and at the other very coarse-grained rocks. Other varieties are markedly porphyritic. To have distinguished the different varieties of basic dykes on the map would have necessitated microscopic work being carried out hand in hand with work in the field, which was impracticable. A selection of the most representative types has been prepared for microscopic study, and will be fully dealt with in the final report.

Wherever an opportunity of examining a section of the dykes presented itself, it was found that they were vertical, or nearly so.

The breadth of the dykes, as would naturally be expected, varies very much in different places, but in no case was the width exposed on the surface very great.

In a few cases there are what appear to be interruptions to the lateral continuity of the dykes and their subsequent resumption upon what seems to be the same line.

A few of the dykes gave off lateral branches which, in some cases, connect parallel veins. In other places, portions of the rock traversed by the dykes are caught up in the centre of the mass.

The intersection of the two rectangular sets of dykes is easily seen where the two rocks are of different textures.

The acidic dykes, though presenting somewhat similar structural features to those above described, have several important points of difference.

The dykes have the same general composition as granite, and belong to the elvanite family. In different portions of the same dyke the composition varies very much; at one place the rocks may present all the characters of a microgranite; at another all those of aplite, with pegmatitic varieties. The absence of hornblende distinctly marks off these dyke rocks from the main mass of granite of which this district is composed. These elvanites are, in all probability, offshoots from some granitic mass not seen within the ground embraced by my work.

The acidic dykes have much more sinuous courses than those of the basic type. They are neither so uniform in their thickness, nor have they such a persistent trend. These very irregular dykes have numerous branches, and what may be termed lateral excrescences. They intersect some of the basic dykes, and are intersected by others.

To the north of Millchester are certain other altered dyke rocks, not referable to any of the varieties known to exist on the field. These will be fully described at a later date.

A feature common to the two sets is that the dykes appear to end almost abruptly when they come in contact with the sedimentary rocks.

Evidence is seen of the shifting of the dykes by faults; but in no case does the shifting on the surface appear to be very great. In the case of vertical dykes, however, this does not prove that the displacement is a small one.

What effect these dykes have upon the reefs and their contents can only be ascertained after the examination of the underground workings has been made.

The banks of the most important creeks are skirted by a width, more or less great, of recent superficial deposits. These also have been delineated upon the map.

The map of the surface geology of Charters Towers resulting from the field work of Messrs. Rands and Maitland was published in 1894, and showed the boundaries between the altered sedimentary rocks and the intruding granite, as well as the positions of the numerous acidic and basic dykes with which the field is intersected.

A later edition, in 1898,* showed also the underground workings on the various reefs as far as they had been carried out at that time. The detailed petrography of the field was, however, never written, nor any description of the character of the reef systems or of the geological structure as revealed by the mining operations.

Sequence of the Igneous Intrusions and of the Formation of the Veins.

Judging by the mapping and remarks of Messrs. Rands and Maitland, and by the exposures now accessible in the mine workings, the general sequence of formation of the various igneous rocks, to the presence of which the occurrence of the gold veins is no doubt attributable, appears to be as follows:—

(1st) The intrusion of the sedimentary beds by a mass of hornblendic granite, and the alteration of those beds into slates and schists by the pressures to which they were exposed during this intrusion.

(2nd) The intrusion of this older granite and the adjoining altered sedimentary rocks by irregularly-shaped and irregularly-disposed felsitic dykes. These are probably apophyses from a second magmatic mass of acidic character, the greater bulk of which solidified at some depth below the present surface of the country.

(3rd) The intrusion of all the above-mentioned rocks by dykes of a more basic character (diorites?). On the western end of the field these basic dykes have a general parallelism in a N.E. and S.W. direction, but on the eastern end of the field they run more nearly from N.W. to S.E. They are probably off-shoots from a mass which has been exposed over a large area on the north-western corner of the field, and which has been mapped by the previously mentioned observers.

Subsequently to the solidification of these three types of igenous rocks occurred the fissuring which allowed of the ascension of the quartz- and metal-bearing solutions from which the present reefs were formed. These fissures cut through sedimentary beds, granitic rocks, and acid and basic dykes indifferently, and their filling with quartz and metallic minerals represents the last traces of vulcanism apparent in the field.

The relation of the quartz reefs to the diorite dykes in point of time of formation is clearly shown by the underground workings of the Brilliant and Brilliant Freeholds Mines, where they cross a large diorite dyke striking from N.W. to S.E. The position of this dyke is shown in broken lines running parallel to the Brilliant Freeholds

* Geological map of Charters Towers Gold Field showing underground workings. On a scale of 4 chains to an inch. Second Edition, 1898. (In six sheets.) G.S.Q. Publication No. 142.

underlie on the 1898 edition of the geological map of the field. As the levels of these mines are followed to the west, they come to a position where the stoping ends, and diorite takes the place of the stoped ground overhead. At first it would appear as if the diorite had intruded the granite subsequently to the formation of the reef, and had thus cut the reef off. More detailed examination, however, shows that the reef quartz occurs right through the diorite dyke (which is in places up to 40 ft. in thickness), but that subsequent movement of the country along the plane of weakness formed by the junction of the diorite dyke and the granite has shifted the reef in the diorite to a higher position. After driving through the diorite and picking up the reef in the granite on the other side, the reef has been stoped back through the diorite at the higher level, and the anterior date of formation of the diorite is thus made apparent. In the workings on the Day Dawn reef in Mills's United numerous examples of dykes of diorite can be seen in the walls, completely cut off by the "formation" of the reef, while the continuity of the reef and "formation" is nowhere interrupted by these dykes.

Influence of Country on Gold Deposition.

Mr. Rands, in his report, says:—"There is a large area of granite between the eastern and western series of dykes which, so far as can be gathered from the surface indications, is practically free from dykes. In this area are situated some of the richest mines, such as the Brilliant, Victory, Victoria, &c. The underground work may, of course, prove the existence of dykes here that are not seen at the surface; and it is impossible, until that work is done, to say what effect, if any, the dykes have on the auriferous character on the reef."

A study of the plotting of the underground workings on the geological map of the field published subsequently to the above remarks points to the conclusion that, though the "diorite" dykes appear to have little, if any, influence on the gold contents of the reefs, the ground underlying the mapped outcrops of the felsitic dykes has been markedly unfavourable to the deposition of gold, though in many cases the reef fissures have been followed right under these outcrops. The best examples of this fact are perhaps the poverty of the ground under the Day Dawn School Reserve and the Church of England ground, where dykes of this character are strongly in evidence on the surface, and where the surrounding payable ground has been mostly all stoped out. An examination of the map will show that in no single instance where outcrops of acid dykes have been depicted on the surface has the ground been rich enough below to allow of any extensive stoping being done. If these acidic dykes are the upper portions of apophyses from a larger mass which has solidified at some unknown depth below the present surface of

the ground, the probability is that they increase in size with depth. The universally observed barrenness of the ground in their neighbourhood points to the conclusion that the rock of which they are formed was in some way unfavourable to the deposition of gold, and if this conclusion is correct it is interesting as a fresh example of the influence of country rock on the gold values of the veins occurring in it.

The occurrence of dykes of this character in the western and deeper portions of the Day Dawn Gold Mines lease possibly accounts for the poverty of the Day Dawn formation in this portion of the company's ground. The absence of such dykes, on the surface at least, in the ground lying to the north and west may thus allow of an alteration of conditions for the better as this ground is opened up.

II.—THE MAIN REEFS.

The Three Chief Systems.

The most important gold-bearing reefs of the Charters Towers field divide themselves into three classes, depending for their differences on peculiarities of occurrence which become apparent with only a very slight acquaintance with the field. The western end of the field is characterised by the Day Dawn reef occupying a fissure remarkable for the regularity of its bearing and dip over a length of some 6,000 ft. of workings, and to a depth of 3,000 ft. from its outcrop. The reef has been worked for payable stone for nearly 5,000 ft. along its course, and to a depth of 2,500 ft. from where payable stone was first struck at about 200 ft. down the Day Dawn P.C. underlie. The chief dividend-paying mines in which this ground has been worked, have been, passing from east to west, the Day Dawn P.C. working from the outcrop, and Mills's Day Dawn United blocking it off; then the Day Dawn Block and Wyndham, and Pfeiffer's Day Dawn Gold Mines blocking it off; to the west of these the Day Dawn Gold Mines. These mines have paid over £2,000,000 in dividends.

The strike of the fissure is nearly due east and west, and, as shown by the plotting of the underground workings, varies little from this direction throughout the entire length of the workings, except where here and there subsequent local movements have shifted it out of its course for a few feet only. The dip varies from 45 deg. to 60 deg., but vertical sections across the centre portion of the formation, worked in the Day Dawn P.C., Block and Wyndham, and Mills's United Mines show only slight variations from a ruling grade of about 50 deg. This well-defined and regular fissure appears, as far as can be judged by the reports of the older workings and the faces at present exposed, to have been filled throughout its entire length by the intrusion of a dark fine-grained igneous rock (diabase?). This rock is locally known as diorite. It has been crushed and sheeted by

subsequent movements along the plane of the fissure, and this crushing has allowed of its infiltration by silica and metal-bearing solutions from below, and its metasomatic replacement by quartz and metallic minerals was thus given free vent.

The average width of this "diorite" formation is from 4 ft. to 6 ft., but many places show widths of up to 20 ft. between the granite walls. Owing to the marked differences of character between the "diorite" formation and the granite walls, the latter are usually exceptionally well-defined. The remarkable regularity of this fissure both in strike and dip over the great extent of workings referred to above, would seem to imply that it could only have been formed by faulting or shearing on a large scale. A study of the detailed mapping of the numerous cross dykes shown on the geological map of the field by Messrs. Rands and Maitland would indicate, however, that any movement of magnitude of this character must have occurred prior to the intrusion of these dykes, and it may well be that, notwithstanding the great dimensions of the fissure, comparatively little differential movement of the walls actually occurred.

The eastern end of the field is characterised, in the first place, by a series of reefs dipping at flat angles (about 35 deg.) to the north-north-west, and showing considerable irregularity both in strike and in dip when followed from point to point. The most important producer in this system of reefs has been the Brilliant reef, while the Victoria hanging-wall and footwall reefs, the Victoria and Queen reef, and the Caledonia reef have also been important members of the series.

The ground over which these reefs have been worked covers an area of nearly a mile in length, in an east and west direction—*i.e.*, approximately along their strike—by about half a mile in width in the direction of their dip. They have afforded the bulk of the richer stone of the field, and, on account of their flatness of dip and the relatively small areas at this end of the field, it has been possible to attack them at numerous points simultaneously from comparatively shallow vertical shafts. They have thus been exhausted at a greater rate than would otherwise have been the case, and at present the visible supplies of stone in the easily accessible ground on these reefs are nearly exhausted.

The veins of this series do not show the regularity of course noticed in the Day Dawn reef, nor are they remarkable for the length of continuous workings on the one chute of stone. The Brilliant reef, however, has been worked over a length of nearly 1,500 ft. on some of the levels, and for a distance of nearly 3,000 ft. down the pitch of the chute. A study of the plotting of the underground workings points to the conclusion that these reefs are all the result of one main fracturing of the granite, the several veins being all more or less definitely connected with each other, and traceable

Plate II.

MILLS'S UNITED GOLD MINE, CHARTERS TOWERS.

THE LARGEST PRODUCER ON CHARTERS TOWERS FIELD.

Returns for 1903: Ore treated, 45,195 tons; value of product, £179,696; dividends, £75,000

from one to the other. Their irregularity of strike and dip indicate that there was little displacement of the walls of the fissure in which they occur. The evidence on this point is confirmed in the case of the Brilliant reef by the occurrence of earlier formed quartz veins which have been cut through by that reef, but have not been shifted more than 2 or 3 ft. when followed from one side to the other of the Brilliant reef. None of these reefs apparently gave promise on the surface of the riches that they were subsequently found to carry at a depth, the Brilliant reef, indeed, having been first struck at a depth of 760 ft. in the Brilliant shaft. This shaft was merely a prospecting shaft being sunk to test the country, and the chute of gold was never worked higher than to a vertical depth of 600 ft. from the surface.

The "formation," or gangue, of these veins shows every indication that it has been formed by the alteration of the granite walls of the fissure by the replacement of its minerals by silica and metallic sulphides introduced in solution from greater depths.

Crossing these east and west veins at right angles and dipping flatly to the northwest are a series of reefs which proved very rich on the surface, and down to a vertical depth of about 600 ft., but which have not of late years added very much to the yield of the field. These reefs are represented by the Victory, the St. George, the Just-in-Time, the Maude St. Ledger, the Worcester Reef, and other small veins. They show a general parallelism, and were characterised, as far as could be judged from the few exposures seen by me, to be fairly tightly imbedded between hard and regular granite walls. They gradually decreased in width as they were followed down the underlie, and do not hold out much prospect of adding materially to the future output of the field.

The Workings on the Day Dawn Reef.

At the surface, according to the generally accepted tradition of the field, the Day Dawn reef was nowhere payable, the shallowest payable stone having been met with at a depth of 200 ft. down the underlie of the Day Dawn P.C. shaft. The "chute" of good stone was at first only some 200 ft. in length. Below that point, however, the body of payable stone rapidly lengthened, till, at a depth of about 1,500 ft. from the outcrop, the reef was stoped continuously (except for the blank under the Church of England ground) for over 3,000 ft. along the course of the fissure.

On its western end this body of stone took the form of a long horizontal tongue, extending for some 2,000 ft. from the main body, and with a depth of some 300 ft. Barren formation was found both above and below this good stone in the workings of the Block and Wyndham and Day Dawn Gold Mines. These latter workings towards the west have exposed no further payable stone for the last 1,000 ft.

of their distance, though the fissure has been proved to extend still further by the workings of the Wallis's Day Dawn Company. In this ground it carries several patches of payable stone.

Below the western end of this horizontally disposed chute of good stone the Day Dawn Gold Mines Company have carried out a considerable amount of prospecting, but, so far, without success.

In the Day Dawn P.C., Block and Wyndham, Mills's United, and Pfeiffer's Day Dawn ground the main body of the payable "chute" on the Day Dawn fissure has been stoped out for a length of about 1,500 ft. and to a depth of about 2,500 ft. from the surface. Below this level no large bodies of payable stone have been found up to the present, though two underlie shafts have been sunk for some distance below. These two underlie shafts—viz., Mills's United and Pfeiffer's Day Dawn—are situated some 1,150 ft. apart, the former having reached a vertical depth of 2,170 ft. and the latter of 2,446 ft. The failure of the latter underlie (the most western of the two) to develop any payable bodies of stone, combined with the poor results from the lower workings of the Day Dawn Gold Mines still further to the west, has had a depressing effect on the hopes formerly entertained as to the prospects of the deeper western ground on the Day Dawn fissure. It was on these hopes that the enterprise of Plant's Deep Mines shaft was initiated, to test this deeper ground, and the hanging up of that shaft was probably to some extent a result of the want of success of these two mines. The Day Dawn fissure, however, shows no sign of fading out in this direction, and it is quite conceivable that the comparative barrenness of the formation in the present western workings is due to local causes which will give way to better conditions as prospecting is further advanced.

On its eastern margin the main body of payable stone of the Day Dawn reef was worked by the Day Dawn P.C. and Mills's United Companies, the former working the shallower ground down to about 900 ft. from the outcrop, and the latter blocking off the former mine in the deeper ground. Followed in an easterly direction the good stone did not go further than a point about 500 ft. from where it was followed down by the P.C. underlie. In Mills's United workings (below the P.C. ground) the eastern extension of the workings passed into the same unpayable ground as they were extended into the Day Dawn School Reserve. The levels below the School Reserve, however, at a depth of about 2,000 ft. from the outcrop, after passing through a poor zone about 200 ft. in length, gradually worked into payable stone. This stone has now been followed by driving the No. 7 East main level into the adjoining New Brilliant Freeholds property, the stone improving rapidly in quality as that property was approached.

The value of the stone in the New Brilliant Freeholds ground is shown by the fact that the first 355 ft. of driving on the No. 7

Plate III.

PFEIFFER'S DAY DAWN GOLD MINE, CHARTERS TOWERS.

VERTICA DEPTH AT END OF 1908, 2,500 FEET.

Ore treated in 1908, 5,096 oz.; value of product, £15,885.

main level gave a return of over £5,000 worth of gold. This level had been driven, at the end of the year just closed, to a distance of 700 ft. from the boundary with Mills's United. The remaining 345 ft. did not disclose such profitable stone, but the fissure is apparently still continuing, and the opening up of the reef by a footwall crosscut from the Brilliant Freeholds shaft, which should meet this level at a point about 250 ft. further east, will permit of a more expeditious exploration of the eastern extension of the reef than is at present possible. The New Brilliant Freeholds Company estimate that with this level and that below, now driven 304 ft. from Mills's United boundary, they have developed 50,000 tons of stone, worth £5 6s. per ton. Whether this estimate prove correct or not there cannot be any doubt that the finding of this body of stone after driving through 200 ft. of barren ground has considerably enhanced the prospects of finding payable stone on the Day Dawn fissure under the eastern section of the field.

About 300 ft. from the eastern boundary in Mills's United Mine the Day Dawn Reef has sent out a hanging-wall reef, which has been followed in four levels to the boundary with the New Brilliant Freeholds ground, and which showed up to 6 ft. of fair stone along the boundary. As this reef is apparently only an off-shoot from the main reef, it may not persist with the same width to any great distance from its junction with the main reef. It, however, forms an additional prospect for the nearer mines along the Day Dawn line.

Reviewing the Day Dawn Reef as a whole, therefore, we see that it occupies a remarkably well-defined and regular fissure, which has been certainly followed over a horizontal distance of more than 6,000 ft., and has been worked for payable stone for a length of nearly 5,000 ft., and to a depth from its outcrop of 2,500 ft., though at the surface its early development is said to have been nearly abandoned, on account of the poverty of the stone. The amount of dividends paid from this reef is recorded as over £2,000,000, while the amount of money distributed in wages for mining and treatment of the stone must have been very considerable. As far as I was able to see, the limits of the fissure to east and west and in depth show no sign of being so close as to preclude the possibilities of further payable bodies of stone being found, and the most important matter that the mining men of the field have now to deal with is that further prospecting of the reef may be carried out with the least possible expenditure of money and time.

Prospecting Work on the Day Dawn Reef.

Below the vertical depth of 2,000 ft. the results up to the present have not been as promising as were expected from the splendid returns obtained above that level. In the sinking of Mills's United and Pfeiffer's Day Dawn underlie shafts is being done all that

can be done to prospect this deeper ground below the main productive ground, and the fact that both are still in the characteristic Day Dawn formation lends colour to the hope that another payable body of stone will eventually be found in this deeper ground.

Towards the west the Day Dawn Gold Mines and Wallis's Day Dawn are gradually extending their workings, the former at a vertical depth of nearly 2,000 ft., and the latter in the shallower ground some distance further west. The Day Dawn Gold Mines has been in barren ground for some considerable time; while Wallis's shaft, though it has met with some patches of payable stone, has not as yet come upon sufficient ore to repay the owners for their outlay in opening up their mine. The expeditious testing of the deeper ground beyond the workings of the Day Dawn Gold Mines is much to be desired in the interests of the field as a whole. It is a venture which, for its satisfactory accomplishment, will require the expenditure of a considerable sum of money in proper equipment, and in preliminary dead work in the sinking of a deep shaft and driving exploratory levels. It cannot be satisfactorily undertaken by a small company restricted to a limited area of ground, or with a working capital insufficient for the proper carrying out of the undertaking.

The most promising prospect for the near future, however, is that offered by the expected continuation of the gold-bearing stone towards the east, as this will bring the reef into that ground, which has already been a magnificent source of wealth in the workings on the shallower lying Brilliant Reef. The Day Dawn fissure in all probability extends as far east, at least, as the Brilliant P.C. shaft—*i.e.*, to a point 1,400 ft. east of the easternmost point to which it has been followed in the Brilliant Freeholds No. 7 main level. A formation is reported to have been met with at 1,435 ft. in the Brilliant P.C. shaft, and the direction of strike of this formation, as given in a drive depicted on the plans of this mine, corresponds with the bearing and depth that would be expected from the Day Dawn fissure at this point. This formation at the bottom of the Brilliant shaft is reported to have carried no payable stone. The fact, however, that a large area of ground to the north of this shaft proved exceptionally rich on the overlying Brilliant formation warrants the hope that the Day Dawn fissure may also prove a valuable gold producer over this area.

At present the eastern extension of the Day Dawn Reef is being prospected at five different points within a distance of 2,000 ft. from the present workings in the Brilliant Freeholds No. 7 main level; while a sixth venture—viz., the sinking of the Queen Cross shaft—is expected to meet the reef at a distance of over 4,000 ft. from the present workings. This latter shaft should now have only about 200 ft. to go to meet the Day Dawn formation, if it continue so far east with the same regularity of strike and dip as it has hitherto

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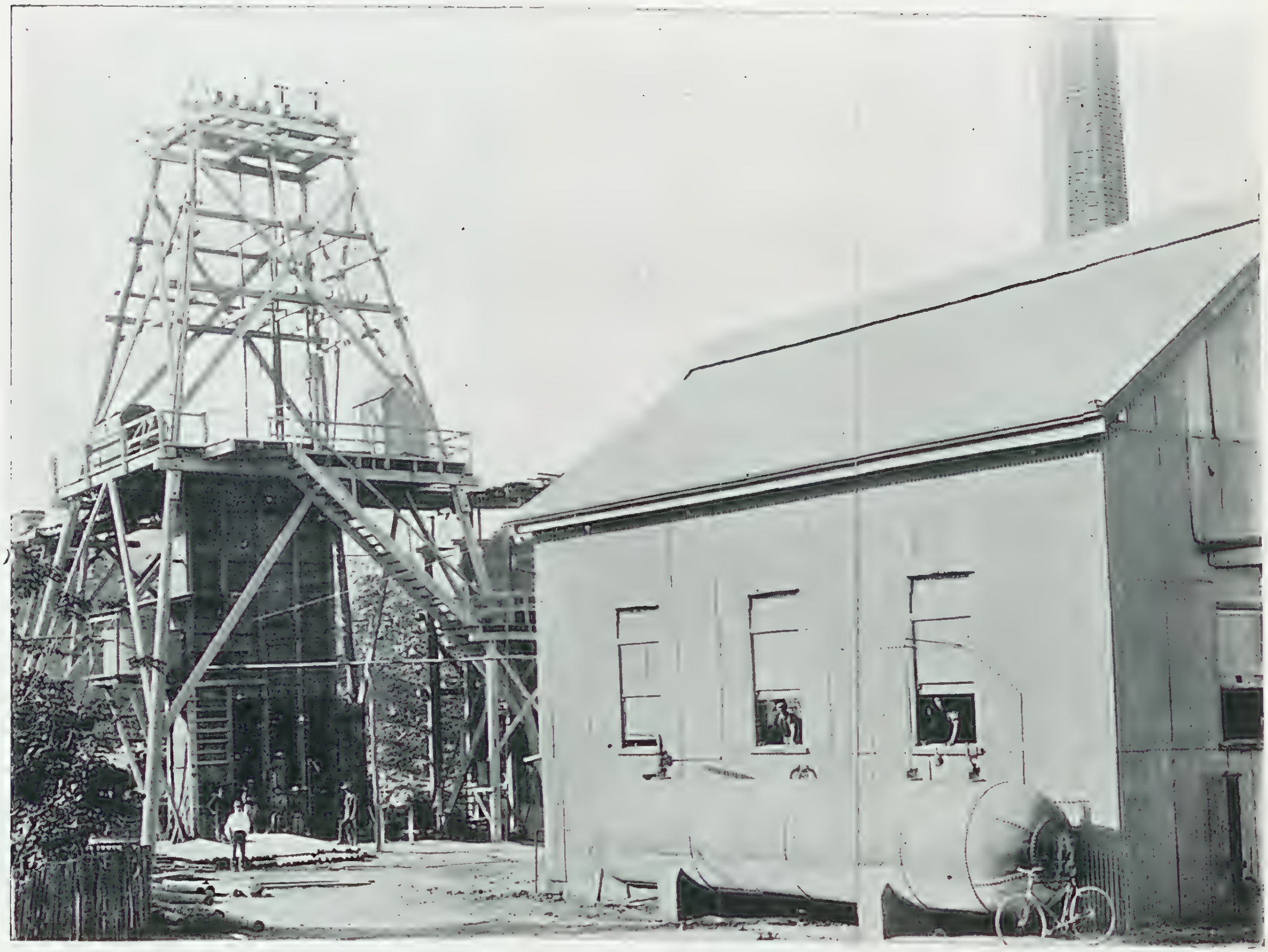

NEW BRILLIANT FREEHOLDS GOLD MINE, CHARTERS TOWERS.

Returns for 1908: Ore treated, 3,474 tons; value of product, £17,424.

shown. Considering the fact that the surrounding ground has already yielded magnificent returns from higher reefs, and that the sinking of the shaft would be prospecting the ground for deeper formations, the sinking of this 200 ft. would certainly seem worth the expenditure involved, were it not that the economical prospecting of the Day Dawn formation, if found, and its economical extraction when found, might easily be frustrated by any want of agreement between the companies holding the surrounding ground. The first desideratum, therefore, for a thorough prospecting of this eastern ground for the Day Dawn formation, is an amalgamation of the different interests represented by the numerous small and irregular areas in the neighbourhood of this shaft.

Of the five points of attack, situated within the first 2,000 ft. from the present most easterly workings on the Day Dawn Reef, the most important, because the nearest and probably the first that will give definite results, is the cross-cutting from the Brilliant Freeholds shaft. This shaft is situated about 260 ft. east of the end of the No. 7 main level, and is sunk to below the 1,500-ft. level—*i.e.*, to the depth at which a crosscut south is expected to cut the extension of that level. The cross-cutting is expected to be about 170 ft. in length, and is now in progress.

A few hundred feet east of this crosscut the Brilliant P.C. Company is reported to be cross-cutting back from their workings on the Brilliant Reef, and at about the same vertical depth. With the ventilation afforded by the breaking through of the Freeholds' crosscut and the probable extension of their level to their eastern boundary, this crosscut of the Brilliant P.C. should allow of the exploration of a large portion of the Brilliant Company's ground. It may also afford funds for the repair of their vertical shaft (burnt out by the fire of 1904), situated some 700 ft. further east, or for the sinking of a new shaft nearer the outcrop and more in the centre of the property.

About 800 ft. east of the Freehold shaft, but considerably further to the dip, the Brilliant Block shaft is being sunk, and is expected to meet the Day Dawn formation at a depth of about 2,040 ft. At the end of February, 1909, this shaft was down about 1,580 ft., leaving probably under 500 ft. to sink. As this shaft lies well to the west of a line drawn north and south from the Brilliant shaft, and as there seems every probability that the Day Dawn fissure will be found to extend as far east as the latter shaft, the prospects that this shaft will also meet the formation seem fairly hopeful. Whether the formation will carry payable stone or not at this point is, however, a much more problematical question, and it is doubtful whether it would not have been better to have waited further developments in the Brilliant Freehold property to the west, and to

have devoted the money (probably some £10,000) which has been expended in sinking, to driving from that property when the workings should be extended far enough east for that purpose.

Another 800 ft. east of the Brilliant Block shaft, and still further to the dip, the Brilliant and St. George shaft is being sunk to test the continuation of the Day Dawn Reef. If the reef continue this far and keep the same course, it should be met with here at a depth of about 2,120 ft. About the end of February last the shaft was reported to have reached a depth of about 1,336 ft., leaving another 800 or 900 ft. of sinking to be accomplished. The prospects that the Day Dawn formation will be found by this shaft are somewhat more problematical than in the case of those situated further to the west. The property to be worked from this shaft has, moreover, on an average, a length of only some 400 ft. along the strike of the reef, being hemmed in on the western side by a portion of the Brilliant ground, and on the eastern side by the Phœbe Mine. It is to be regretted that some amalgamation of the ground in the neighbourhood of this shaft could not have been made before the expenditure of sinking the shaft (probably some £10,000) was undertaken, and the economical prospecting and working of the whole of the ground in the neighbourhood have been thus assured.

Almost due south of the Brilliant and St. George shaft, and accordingly about 1,900 ft. east of the present most eastern workings on the Day Dawn Reef, Clarke's Brilliant and Day Dawn shaft is being sunk to prospect the eastern extension of the reef in the shallower ground. The shaft is already down 1,040 ft., and should be approaching the reef if it keeps its regular strike, and dip this far to the east. This shaft is in an awkward position, as it is hemmed in to the north and to the west by the Victory Company's ground, so that it will be impossible for it either to drive on the reef to the west or to sink to any distance on the underlie.

Recent Development on the Brilliant Reef.

The Brilliant formation has been followed down, as an easterly pitching chute of irregular outline with a maximum width of about 1,500 ft., from the point where it was first met with at a depth of 760 ft. in the Brilliant P.C. shaft, for a distance of over 3,000 ft. to the lowest workings. At the bottom of the Brilliant Extended underlie, now at a vertical depth of 2,800 ft. from the surface, the sink still shows payable stone. On the eastern side of this chute the ground becomes broken up, and several vertical shafts and drives have failed to disclose anything in the nature of a well-defined fissure that holds out much prospect of leading on to payable bodies of stone. On the western side the Brilliant Deep Levels workings have developed large bodies of unpayable stone at a vertical depth of 2,000 ft. from the surface, having driven on this class of material for over 1,500 ft.

BRILLIANT DEEPS GOLD MINE, CHARTERS TOWERS.

Plate V.

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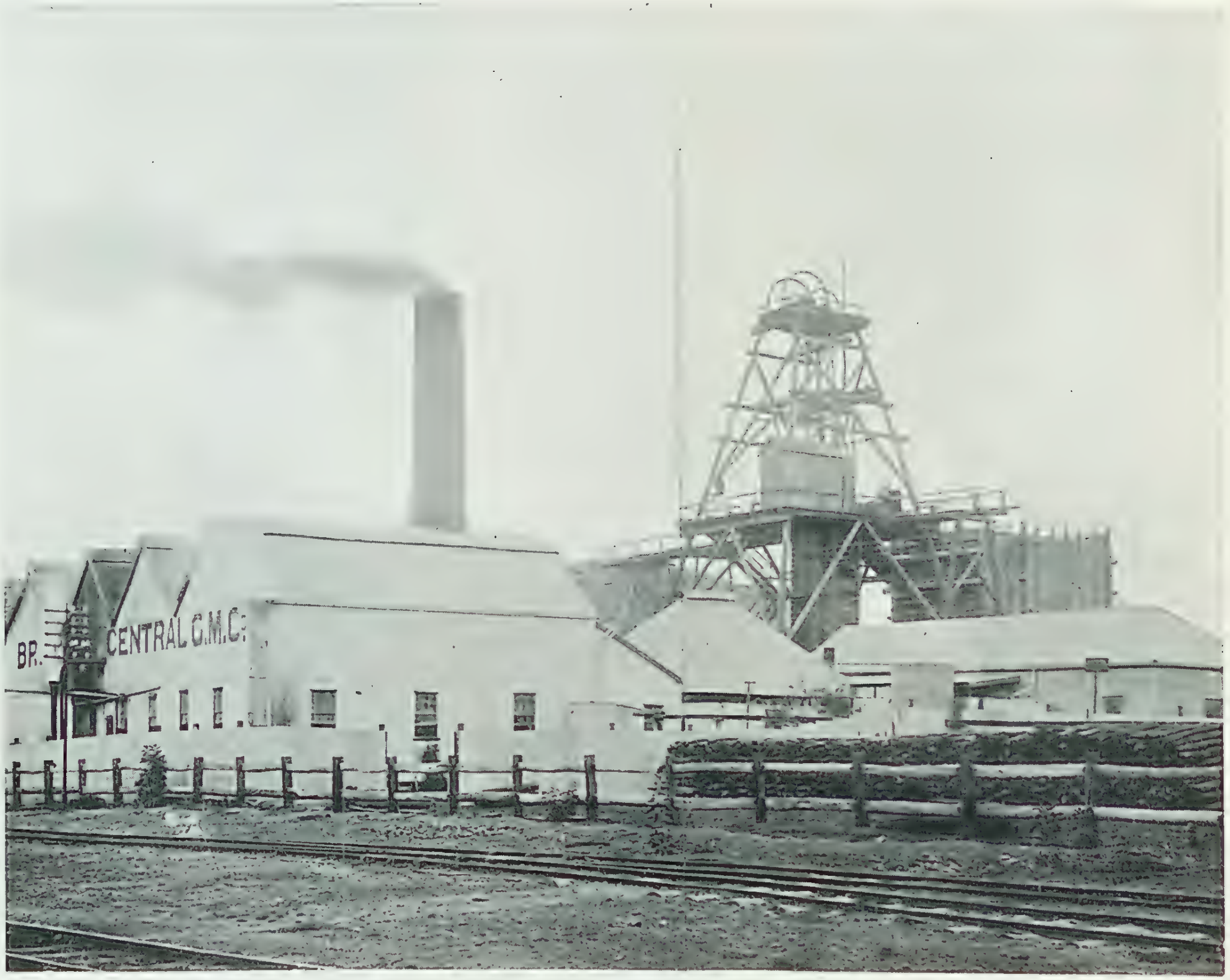

BRILLIANT CENTRAL GOLD MINE, CHARTERS TOWERS.

During 1908 treated 14,251 tons, for a return valued at £39,624; dividends, £5,000.

Recently, however, their western drive has developed what is reported to be over 2½ ft. of heavily mineralised stone, a crushing of 100 tons of which is reported as having returned over £9 per ton. Without an inspection of this development it is difficult to form any opinion as to its character, or as to its bearing on the prospects of another "chute" of payable stone on the Brilliant line of reef. There seems no reason, however, why such another "chute" of stone should not occur, and this development may prove the means of adding considerably to the productiveness of the surrounding properties.

Conclusion.

Taking the field as a whole, therefore, the most hopeful prospect of continued productiveness would seem to lie in the development of the eastern ground on the Day Dawn fissure, and the activity of the mines at this end of the field in sinking their shafts to develop this ground will demonstrate within a very short time whether this prospect is likely to be realised or not. In this connection, it has been pointed out that an amalgamation of interests would in many cases be an advantage, as it would spread the burden of expensive exploration over a greater number of shareholders, and would allow of the more economical mining of the ground if anything should be found. The smaller areas, which were perhaps suitable for the more flatly dipping and richer reefs, now practically exhausted, are quite unsuitable where expensive prospecting has to be undertaken before payable bodies of stone can be expected to be developed.

The western ground also affords prospects which, however unpromising at present, may at any time brighten sufficiently to allow of a more energetic development of this end of the field.

On the Brilliant line of reef the recent find of good stone at a depth of over 2,000 ft. in the Brilliant deep levels mine, and nearly 1,000 ft. from the nearest payable stone on that reef, may lead to a very considerable addition to production.

Brisbane, 20th March, 1909.

By Authority: Anthony James Cumming, Government Printer, Brisbane.

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Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY OF QUEENSLAND.

(B. Dunstan, Government Geologist.)

Publication No. 227.

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TO

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(Vol. III. of New Series.)

By RUSSELL DIXON.

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BY AUTHORITY: ANTHONY JAMES CUMMING, GOVERNMENT PRINTER.

1914.

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(215.) Report on the Cloncurry Copper Mining District (Parts I. and II.) (with one Map, one Plate, seventy-six Plans, and thirty-two Figures). L.C.B. 8vo. 1908. 4s. 6d. (Out of print.)

(216.) The Great Fitzroy Copper and Gold Mine, Mt. Chalmers, Rockhampton District (with fifteen Plates). B.D. 8vo. 1907. 1s. 6d. (Out of print.)

(217.) Geological Sketch Map of Queensland, showing mineral localities. Scale, 40 miles to an inch. Third Edition. Revised to December, 1907. 1s.

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(226.) Sketch Map of East-Central Queensland Gold, Mineral, and Coal Fields, between Rockhampton, Gladstone, and the Dawson and Mackenzie Rivers. Scale, 4 miles to 1 inch. Compiled by W.H.G. 1910.

(227.) Index [No. 5] to Publications Nos. 215 to 226, inclusive, being Vol. III. of New Series. By Russell Dixon.

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